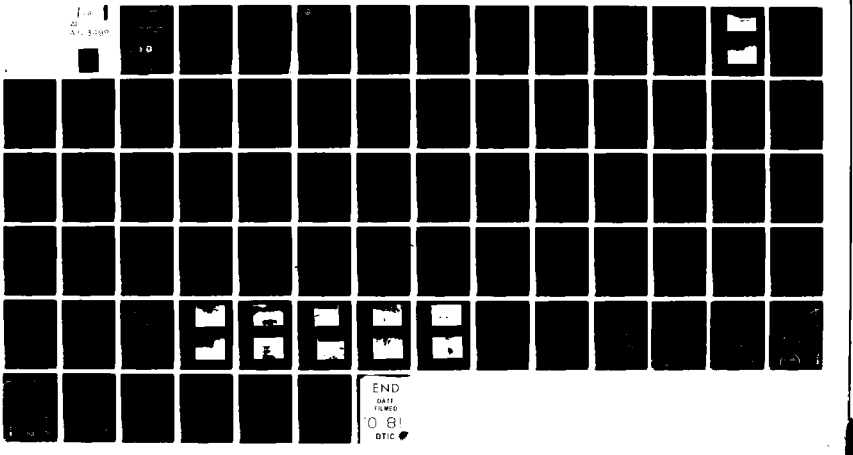
AD-A103 498 NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON --ETC F/G 13/13
NATIONAL DAM SAFETY PROGRAM. ETRA LAKE DAM (NJ00298), RARITAN R--ETC(U)
JUL 81 J J WILLIAMS DACW61-79-C-0011
UNCLASSIFIED DAEN/NAP-53842/NJ00298-81/ NL



LEVEL II

AD A103498

RARITAN RIVER BASIN
ROCKY BROOK, MERCER COUNTY
NEW JERSEY

ETRA LAKE DAM
NJ 00298

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

JULY 1981

REPT. NO. DAEN/NAP-53842/NJ00298-81/07

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: DAEN/NAP-53842/NJ00298-81/07	2. GOVT ACCESSION NO.: AD-A103 498
3. RECIPIENT'S CATALOG NUMBER:	
4. TITLE (and Subtitle): Phase I Inspection Report National Dam Safety Program Etra Lake Dam, NJ00298 Mercer County, NJ	5. TYPE OF REPORT & PERIOD COVERED: FINAL report
	6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): Williams, John J., P.E.	8. CONTRACT OR GRANT NUMBER(s): DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS: O'Brien & Gere Engineers Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS: NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625	12. REPORT DATE: July 1981 13. NUMBER OF PAGES: 50
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16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

National Dam Safety Program. Etra Lake Dam (NJ 00298), Raritan River Basin, Rocky Brook, Mercer County, New Jersey. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams
Embankments
Visual Inspection
Structural Analysis
National Dam Safety Program
Etra Lake Dam, N.J.
Spillways
Seepage

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

11 AUG 1981

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Etra Mill Pond Dam in Mercer County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Etra Mill Pond Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in fair overall condition. However, the spillway is considered inadequate, as 23 percent of the 100 year design flood would cause the dam to be overtopped. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. However, to assure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Clear the embankment of all brush and trees. Backfill resulting voids with suitable compacted material. Establish controlled protective vegetation on the embankment slopes.

b. Monitor the seepage downstream of the dam regularly.

c. Consider increasing the spillway capacity to provide for safe passage of the Spillway Design Flood.

d. Repair the concrete in the spillway and bridge.

e. Inspect the reservoir drain and repair if necessary to insure satisfactory operation.

NAPEN-N
Honorable Brendan T. Byrne

f. Inspect the diversion system to the former mill to assess its suitability for use as an auxiliary reservoir drain.

g. Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Smith of the Fourth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

ETRA MILL POND DAM (NJ00298)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 30 April 1981 and 6 and 13 May 1981 by O'Brien and Gere Engineers Inc. under contract to the U.S. Army Engineer District, Philadelphia, in accordance with the National Dam Inspection Act, Public Law 92-367.

Etra Mill Pond Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in fair overall condition. However, the spillway is considered inadequate, as 23 percent of the 100 year design flood would cause the dam to be overtopped. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. However, to assure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Clear the embankment of all brush and trees. Backfill resulting voids with suitable compacted material. Establish controlled protective vegetation on the embankment slopes.

b. Monitor the seepage downstream of the dam regularly.

c. Consider increasing the spillway capacity to provide for safe passage of the Spillway Design Flood.

d. Repair the concrete in the spillway and bridge.

e. Inspect the reservoir drain and repair if necessary to insure satisfactory operation.

f. Inspect the diversion system to the former mill to assess its suitability for use as an auxiliary reservoir drain.

g. Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

APPROVED: Roger L. Baldwin

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE: 11 Aug 81

DELAWARE RIVER BASIN

Name of Dam: Etra Mill Pond
County & State: Mercer County, New Jersey
Inventory Number: NJ 00298

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.

For

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Custom House-2nd & Chestnut Streets
Philadelphia, PA 19106

August 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and anlayses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data availabe to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT

NATIONAL DAM INVENTORY PROGRAM

Name of Dam:	Etra Mill Pond Dam
State Located:	New Jersey
County Located:	Mercer
Stream:	Rocky Brook
Coordinates:	N40°15.2', W74°30.2'
Dates of Inspection:	April 30, 1981, May 6, 1981 and May 13, 1981

ASSESSMENT

Etra Mill Pond Dam is an earth embankment about 300 feet long and 11 feet high. The embankment has a crest width of about 25 feet with a paved roadway constructed on it. An Ambursen type reinforced concrete spillway is located at about the midpoint of the dam. The upstream slope of the embankment averages 2H:1V while the downstream slope of the embankment averages 1H:1V.

The dam is classified as "Small" size. Based on the potential for damage due to dam failure, the structure is judged to be a "Low" hazard. Accordingly, the Spillway Design Flood (SDF) range from the fifty-year flood to the one-hundred year flood. The one-hundred year flood was selected as the SDF. The SDF was developed and routed through the structure. Based on a review of the results, the spillway is capable of passing only 22 percent of the SDF without overtopping the embankment. The spillway is classified as "Inadequate".

The Owner should retain the services of a licensed professional engineer experienced in the design and construction of dams to assist in complying with the following recommendations and remedial measures.

The recommendations and remedial measures should be initiated soon.

a. Facilities

1. The embankment should be cleared of all brush and trees. Resulting voids should be backfilled with suitable compacted material. Controlled protective vegetation should be established on the embankment slopes.

2. The seepage downstream of the dam should be monitored regularly.

3. The capacity of the spillway should be increased to provide for safe passage of the SDF.

4. The concrete in the spillway and bridge should be repaired.

5. The reservoir drain should be inspected and repaired if necessary to insure satisfactory operation.

6. The diversion system to the former mill should be inspected to assess its suitability for use as an auxiliary reservoir drain.

b. Operation and Maintenance Procedures

The dam should be inspected annually with particular attention directed to the assessment of seepage problems and the condition of the concrete in the spillway and bridge.

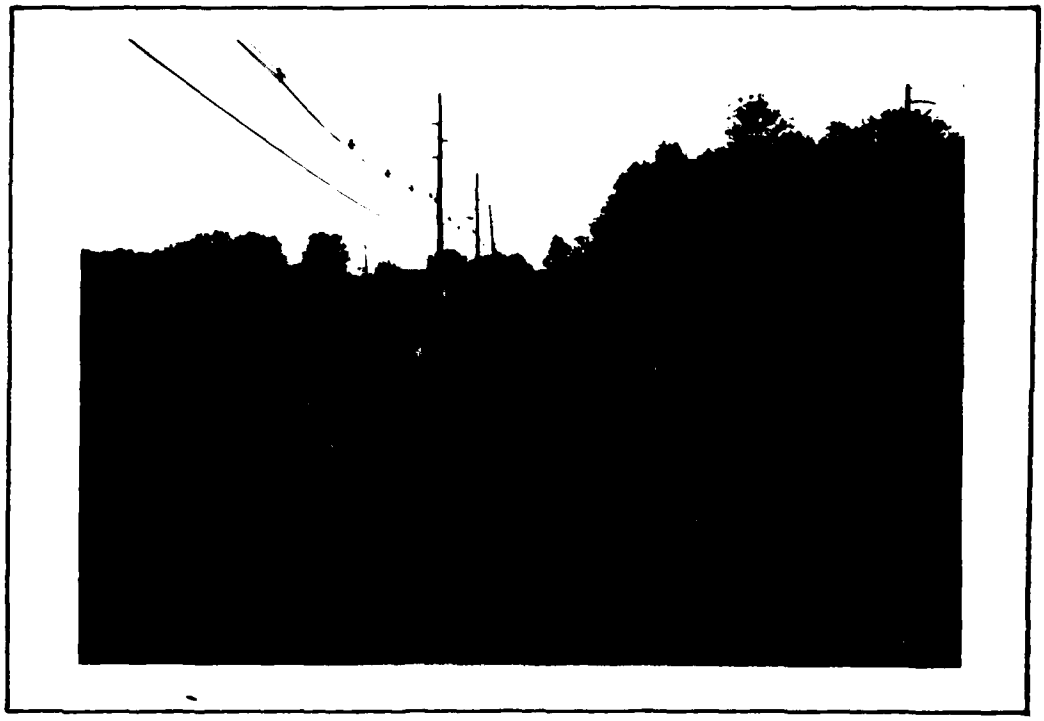
O'BRIEN & GERE ENGINEERS, INC.

John J. Williams

John J. Williams, P.E.
Vice President
New Jersey Registration No. 24916

Date: 28 July 1981

OVERVIEW FROM THE LEFT ABUTMENT. NOTE THE CONCRETE HEADWALL FOR THE ABANDONED MILL RACE INLET. (5/6/81)



OVERVIEW FROM THE RIGHT ABUTMENT. (5/6/81)

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(Continued)

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM
ETRA MILL POND DAM
INVENTORY NUMBER NJ 00298

1.1 General

a. Authority. This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract #DACW61-80-D-0013 between O'Brien & Gere Engineers, Inc. and the United States Army Corps of Engineers, Philadelphia District.

b. Purpose of Inspection. The purpose of the inspection is to evaluate the structural and hydraulic condition of Etra Mill Pond Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 Project Description (Based on information provided by the New Jersey Department of Environmental Protection (NJDEP) and supplemented by field observations.)

a. Description of Dam and Appurtenances. Etra Mill Pond Dam is an earth embankment about 300 feet long and 11 feet high. The crest width of the embankment averages about 25 feet. A paved roadway is constructed on the crest of the embankment. The average slope of the upstream face of the dam is about 2H:1V while the average slope of the downstream face of the dam is about 1H:1V.

An Ambursen reinforced concrete gravity spillway is constructed near the mid point of the embankment. Spillway discharge is passed through the embankment by means of a bridged opening. A 16-inch diameter reservoir drain gate is located in the upstream endwall of the spillway structure.

b. Location. Etra Mill Pond Dam is located in Mercer County approximately one mile southeast of Hightstown, New Jersey. The dam site is shown on the USGS Quadrangle entitled "Hightstown, New Jersey" at coordinates N40°15.2', W74°30.2'. A regional location map for Etra Mill Pond Dam is included as Figure 1, Appendix E.

c. Size Classification. Etra Mill Pond Dam has a maximum height of approximately 11 feet. The maximum storage at the low point of the top of the dam is estimated to be 114 acre feet. The dam is therefore classified as a "Small" size structure (height less than 40 feet, storage less than 1,000 acre feet).

d. Hazard Classification. No structures for human habitation in the downstream floodway would be affected by a failure of the dam. The extent of property damage as a result of dam failure is judged to be insignificant. The dam is therefore classified as a "Low" hazard potential structure.

e. Ownership. The dam is owned by East Windsor Township, New Jersey. Correspondence may be directed to: Ward Street, Municipal Building, East Windsor Township, New Jersey 08520, Attn: Mr. John Santouosso, Township Engineer.

f. Purpose of Dam. The dam was originally constructed to provide hydropower for a mill. The impoundment is presently used for incidental recreation.

g. Design and Construction History. The original dam at the site was constructed sometime prior to 1930. No information relative to the design and construction of this dam is known to exist.

The application to reconstruct the dam to its present configuration was made in May, 1930. The Owner was Mr. Abraham Katz and the Engineer was John L. Weber, P.E. of Trenton, New Jersey. Construction began in August, 1930. The foundation was reported to consist of "gravel underlying clay." The spillway foundation was exposed and inspected by representatives of the New Jersey Water Policy Commission (NJWPC) in August, 1930. The NJWPC recommended several changes with regard to the foundation design.

A second NJWPC inspection of the dam was made on November 20, 1930. At this time it was noted that: 1) the concrete in the buttresses "contained many dry batches", 2) the blow-off pipe was located about 2 feet higher than shown on approved drawings and 3) that some leakage was noted under the spillway deck.

A NJWPC inspection of the dam was made on January 3, 1931. At this time, the pond was approximately half full. Seepage was noted at the base of the first buttress of the spillway (right side). Deposits of fines were observed at this location. The Owner was directed to dewater the impoundment and make appropriate repairs. A subsequent NJWPC inspection was made on March 16, 1931. The water surface was at the spillway crest and no leakage was observed. Acceptance of the completed structure was recommended.

The embankment was overtopped and breached in 1934 and in September, 1938. It was reported that the embankment was overtopped for about 10 hours and the maximum depth of flow over the road was about one foot in the 1938 event.

The September 1938 damage was repaired in January, 1939. The spillway crest elevation was reported to be lowered by 0.3 feet as recommended by the State. It is not known when the 1934 damage was repaired.

No additional information relative to design or construction history is available.

h. Normal Operating Procedures. According to the Owner's representative, Mr. John Santouosso, no operating procedures are currently in effect at this dam.

1.3 Pertinent Data

a. Drainage Area.

Square Miles	9.1

b. Discharge at Dam Site (cfs).

Low Point of Dam (Elev. 99.9)	310.

c. Elevation (Feet above NGVD).

Spillway Crest	98.6
Low Flood Notch	98.3
Design Top of Dam	101.6
Low Point Top of Dam (Surveyed)	99.9
Spillway Apron (Surveyed)	88.8

d. Reservoir Length (Feet).

Normal Pool (Elevation 98.3)	2,200
Low Point Top of Dam (Elevation 99.9)	3,000

e. Reservoir Storage (Acre Feet).

Normal Pool (Elevation 98.3)	66
Low Point Top of Dam (Elevation 99.9)	114

f. Reservoir Surface Area (Acres).

Normal Pool (Elevation 98.3)	21
Low Point Top of Dam (Elevation 99.9)	40

g. Dam.

Type	Earth Embankment
Length	±300 feet
Height	±11 feet
Top Width	±25 feet
Side Slopes (Upstream)	Average 2H:1V
Side Slopes (Downstream)	Average 1H:1V
Zoning	Unknown
Impervious Core	Unknown
Cutoff	Unknown
Grout Curtain	Unknown

h. Spillway.

Type	Box Inlet Drop Spillway Reinforced Concrete Ambursen Type
Length of Weir (Elevation 98.6)	49 Feet
Length of Low Flow Notch (Elevation 98.3)	12 Feet
Gate	16-inch diameter located in upstream spillway wall
Upstream Channel	Impoundment
Outlet Channel	Natural Stream

i. Diversion and Regulating Structure. Diversion to former mill appears to be blocked. Size and closure method for diversion unknown.

j. Reservoir Drain. The reservoir drain is reported to be a 16-inch diameter cast iron pipe and gate located through the base of the upstream wall of the spillway.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. The engineering data provided by the New Jersey Department of Environmental Protection (NJDEP) includes the following:

1. Correspondence file initated 1929.

2. Two design drawings of the dam entitled Mr. A. Katz, Dam, dated April, 1930.

2.2 Construction

Inspection and progress reports relative to the construction of the box inlet drop spillway reinforced concrete Ambursen type spillway, were provided by the NJDEP.

2.3 Operation

According to the Owner's representative, no operating program is currently in effect for the dam.

2.4 Evaluation

a. Availability. The engineering data used in preparing this report was provided by the NJDEP.

b. Adequacy. Based on a review of the material provided by the NJDEP, observations made during the field investigation and conversations with the Owner's representative, it appears that adequate information is available for a Phase I evaluation.

c. Validity. There appears to be no reason to question the validity of the data provided by the NJDEP.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspections of Etra Mill Pond Dam took place on April 30, May 6, May 13, and June 3, 1981. At the time of the inspections, the water surface was approximately 0.2 feet above the spillway crest low flow notch. The photographs which appear in Appendix D of this report were taken on May 6, 1981. No underwater areas were included in the inspection. The observations and comments of the field inspection team are included in the checklist which is Appendix B of this report. The overall apearance of the facility indicated that the dam and its appurtenances are inadequately maintained.

b. Dam. The vertical and horizontal alignment of the dam appears to be fair. No significant settlement or slope misalignment was noted. A survey of the vertical alignment of the top of the dam was made by the inspection team. The maximum variation in vertical alignment is about 1.7 feet. A sketch of the survey results is included in Appendix E, Sheet 5.

A low concrete wall is constructed along the upstream face of the embankment from the south abutment and extends for about 100 feet along the crest of the embankment. A concrete headwall structure is located at the northern end of this wall. The headwall is apparently a portion of the intake structure for an abandoned diversion system to a former mill. Timber gate guides are evident on this structure above the water level. The concrete wall and headwall appear to be in good condition.

The remainder of the upstream face of the dam which is constructed on a slope of about 2H:1V, is intermittently covered by uncontrolled vegetative growth consisting of reeds, grasses and brush. No appreciable erosion was observed in the areas where no vegetative cover exists.

The downstream face of the embankment is essentially flat in the abutment areas. However, in the vicinity of the spillway the slopes are approximating 1H:1V. The entire downstream face of the embankment is covered with dense uncontrolled vegetation including several large trees. Seepage was located in the toe area of the embankment on both sides of the spillway. On the left side of the spillway and about 10 feet from the channel, a spongy area was located. No puddled seepage was noted at this location. However, on the right side of the spillway, approximately 50 feet from the spillway, puddled water was detected. No flow was observed in the puddled water.

c. Appurtenant Structures. The alignment of the spillway structure is good. No cracks were evident in the structure; however, the concrete is spalled and reinforcing steel is exposed in at least two buttresses.

No cracking was noted in the bridge abutments. However, concrete tee beams of the road deck are spalled and reinforcing steel is exposed. According to Mr. John Santouosso, East Windsor Township Engineer, the allowable bridge load is restricted because of the defective beams.

According to information provided by NJDEP, the reservoir drain was constructed through the upstream endwall of the spillway. The operating mechanism was not evident during the inspections. The spillway crest was reportedly lowered during repairs made in 1939. However, no evidence of this modification are apparent.

d. Reservoir Area. The reservoir slopes are relatively flat and well covered with vegetation. No slope stability problems are apparent along the shoreline of the reservoir. A significant amount of sedimentation was observed in the impoundment.

e. Downstream Channel. The discharge from the spillway enters the natural channel downstream of the dam. The channel overbanks are heavily overgrown with brush and trees. Peddie Lake is located about 1.5 miles downstream. No inhabitable dwellings are located between Etra Mill Pond Dam and Peddie Lake that would be endangered by a failure of Etra Mill Pond Dam.

SECTION 4

OPERATIONAL FEATURES

4.1 Procedures

Based on a review of all available information and interviews with the Owner's representative, no operational procedures are associated with this dam.

4.2 Maintenance of Dam

According to the Owner's representative, maintenance is performed only on an as needed basis for this dam.

4.3 Maintenance of Operating Facilities

According to the Owner's representative, maintenance of operating facilities is performed only on an as needed basis for this dam.

4.4 Description of any Warning System in Effect

According to the Owner's representative, no warning system is in effect for this dam.

4.5 Evaluation of Operational Adequacy

It is not known if the reservoir drain is operational. No operating mechanism is evident. The diversion system appears to be abandoned and sealed off.

The dam is accessible for all weather conditions.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features

a. Design Data. Based on a review of available information pertaining to the dam reconstruction in 1931, the drainage area contributing to Etra Mill Pond Dam is 9.09 square miles, the maximum depth of the pond is 10 feet and the surface area of the pool is 21 acres. The drainage basin has a maximum length of about 5.5 miles and a maximum width of about 2.5 miles. The topography ranges from a maximum of Elevation 350 to Elevation 98.3 at normal pool. The drainage area is a mixture of farmland and woodland with Perrineville being the only community within the basin.

For further information, refer to the calculations and computer printout included in Appendix C of this report.

b. Experience Data. According to the Owner's representative, no records of reservoir level or rainfall are maintained for this dam. Based on a review of available information, the dam was overtopped and breached in 1934 and 1938. During the storm of September 21 and 22, 1938, water was reported to have flowed at a depth of one foot over the top of the dam for at least 10 hours.

The time to completely drain the reservoir has been estimated to be approximately 1.2 days using the 16-inch diameter drain pipe.

c. Visual Observations. At the time of the inspections, it appeared that the spillway could perform as designed. The operational condition of the reservoir drain system could not be appraised and the abandoned diversion system appeared to be blocked off.

d. Overtopping Potential. Etra Mill Pond Dam is a "Small" size, "Low" hazard structure. Accordingly, the Spillway Design Flood (SDF) ranges from the fifty to the one-hundred year flood. The one-hundred year flood was selected as the SDF. The SDF hydrograph was developed and routed through the impoundment and dam with the starting water surface at the spillway crest, Elevation 98.3. The peak inflow and discharge rates during this event are about 1400 and 1390 cfs, respectively. The spillway is capable of discharging approximately 22 percent of the SDF prior to overtopping of the embankment. The SDF event overtops the embankment by about 0.8 feet for a period of 14.75 hours.

e. Spillway Adequacy. The spillway is incapable of discharging the SDF prior to overtopping; therefore, the spillway is judged to be "Inadequate."

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. At the time of the inspections, the embankment appeared to be in fair condition. No evidence of slope instability was noted. However, areas of isolated seepage were located on both sides of the spillway at the downstream toe area. No deposits of fines were noted at either location.

The concrete spillway appeared to be in fair condition. Concrete was spalled and reinforcing steel exposed in at least two of the support buttresses. No misalignment was evident in the structure.

Concrete tee beams of the road deck are spalled and reinforcing steel is exposed in the highway bridge which is an integral part of the dam.

Based on the field inspection, Etra Lake Dam appears to be stable under any expected static loading conditions.

b. Design and Construction Data. Analyses of the buttressed reinforced concrete spillway were provided by the NJDEP. The analyses show that the resultant of forces is located within the middle third of the base width of the spillway section for a head of water one foot above the spillway crest.

c. Operating Records. According to the Owner's representative, no operating records are maintained for this dam.

d. Post Construction Changes. Refer to Section 1.2g.

e. Seismic Stability. The dam is located in Seismic Risk Zone 1 of the "Seismic Zone Map of Contiguous States." A dam located in Seismic Zone 1 is generally considered to be stable under any expected earthquake loading if it is stable under static loading conditions.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Evaluation. Based on the visual inspection, Etra Mill Pond Dam is judged to be in fair condition. Cover for the embankment slopes varies from being overgrown with brush and trees to bare unprotected earth. Seepage was detected near the downstream toe on both the left and right sides of the spillway. The concrete in the spillway structure is spalled and reinforcing steel is exposed in at least two of the buttresses.

The concrete in the bridge abutments is in fair condition. The concrete in the bridge beams is in poor condition. The highway bridge is an integral part of the dam.

The SDF selected for Etra Mill Pond Dam ("Small" size, "Low" hazard) is the 100 year flood event. A review of the results of the hydrologic and hydraulic analyses indicated that the spillway is capable of passing approximately 22 percent of the SDF prior to overtopping the embankment.

The operational condition of the reservoir drain is unknown.

b. Adequacy of Information. The information provided by the NJDEP, conversations with the Owner's representative and observations made during the field inspection provided adequate information for a Phase I evaluation.

c. Urgency. The remedial measures recommended in Section 7.2 should be initiated soon.

d. Necessity for further Investigation. Further detailed studies are not considered necessary because Etra Mill Pond Dam is a "Small" size, "Low" hazard dam.

7.2 Recommendations and Remedial Measures

The Owner should retain the services of a licensed professional engineer experienced in the design and construction of dams to assist in complying with the following recommendations and remedial measures.

The recommendations and remedial measures should be initiated soon.

a. Facilities

1. The embankment should be cleared of all brush and trees. Resulting voids should be backfilled with suitable compacted material. Controlled protective vegetation should be established on the embankment slopes.

2. The seepage downstream of the dam should be monitored regularly.

3. The capacity of the spillway should be increased to provide for safe passage of the SDF.

4. The concrete in the spillway and bridge should be repaired.

5. The reservoir drain should be inspected and repaired if necessary to insure satisfactory operation.

6. The diversion system to the former mill should be inspected to assess its suitability for use as an auxiliary reservoir drain.

b. Operation and Maintenance Procedures

The dam should be inspected annually with particular attention directed to the assessment of seepage problems and the condition of the concrete in the spillway and bridge.

APPENDIX

A

Check List Engineering Data

Design, Construction, Operation

Phase I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Etra Mill Pond Dam

ID # NJ 00298

ITEM	REMARKS
AS-BUILT DRAWINGS	None made available.
REGIONAL VICINITY MAP	Refer to Appendix E, Figure 1.
CONSTRUCTION HISTORY	Refer to Sect. 1.2 g.
TYPICAL SECTIONS OF DAM	Refer to Appendix E, Figure 3.
OUTLETS - PLAN	Refer to Appendix E, Figure 3.
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	None made availalbe
RAINFALL/RESERVOIR RECORDS	None made available.

ITEM	REMARKS
DESIGN REPORTS	None made available.
GEOLOGY REPORTS	None made availabe.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Limited to information submitted with Dam Application.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None made available.
POST-CONSTRUCTION SURVEYS OF DAM	None made available.
BORROW SOURCES	No information available.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Refer to Section 1.2 g.
HIGH POOL RECORDS	None made available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None made available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Refer to Section 1.2 g.
MAINTENANCE OPERATION RECORDS	None made available.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Refer to Appendix E, Figure 3.
OPERATING EQUIPMENT PLANS & DETAILS	No information was made available.
MISCELLANEOUS	

APPENDIX

B

Check List

Visual Inspection

Phase I

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam Etra Mill Pond Dam County Mercer State New Jersey National ID # NJ 00298

Type of Dam Earth Embankment Hazard Category Low

Date(s) Inspection April 30, 1981 May 6&13,1981 June 3, 1981 Weather Cloudy/with rain (4/30/81) Temperature 65° (4/30/81)

Pool Elevation at Time of Inspection 98.5 ± M.S.L. Tailwater at Time of Inspection 90 ± M.S.L.

Inspection Personnel:

L.R. Beck
Lee DeHeer (6/3/81)
R.E. Horvath
J.F. Rauschkolb

R.E. Horvath Recorder

Remarks:

The inspection team was accompained by Mr. John Santouosso, East Windsor Township Engineer on 4/30/81 and Mr. Peter Niven, Assistant Township Engineer on May 6, 1981.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No cracking was noted in the embankment.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No evidence of movement was noted in the vicinity of the embankment toe.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical and horizontal alignment of the crest is fair.	
RIPRAP FAILURES	No riprap is in place.	Riprap should be installed on the upstream face of the embankment for erosion protection.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No movement or cracking was noted.	
ANY NOTICEABLE SEEPAGE	Seepage was evident on both sides of the spillway. A "spongy" area was located about 10 feet to the left of the spillway channel. "Ponded" water was located about 50 feet to the right of the channel. No flow was observed in the puddled water.	These conditions should be observed during periodic inspections to detect any changes in flow quantity or quality.
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

Reservoir Drain

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N/A	
INTAKE STRUCTURE	Submerged.	
OUTLET STRUCTURE	According to available information, the outlet is constructed through the spillway structure. However, due to flow conditions, the structure was not observed.	
OUTLET CHANNEL	The outlet channel is the spillway channel.	
EMERGENCY GATE	16-inch diameter gate located in upstream spillway wall.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The concrete weir appear to be in good condition. The concrete in at least two of the buttresses is spalled and reinforcing steel is exposed.	The concrete should be repaired.
APPROACH CHANNEL	Impoundment.	
DISCHARGE CHANNEL	Discharge from the spillway passes through the embankment by means of a bridged opening in the embankment. The flow enters the natural downstream channel downstream of the bridge.	
BRIDGE AND PIERS	The concrete in the bridge structure appears to be in poor condition.	The concrete should be repaired.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir slopes are relatively flat and well covered with vegetation. No slope stability problems are apparent along the shoreline of the reservoir.	
SEDIMENTATION	A siginificant degree of sedimentation was observed in the impoundment.	Limits the storage capacity of the reservoir.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The natural channel downstream of the dam appears to be relatively free of debris and obstructions. The overbanks are heavily overgrown with brush and trees.	
SLOPES	The downstream channel slope and channel sideslopes are relatively flat. Peddie Lake is located about 1.5 miles downstream.	
APPROXIMATE NO. OF HOMES AND POPULATION	No structures for human habitation in the downstream floodway would be affected by a failure of the dam. The extent of property damage as a result of dam failure is judged to be insignificant. The dam is therefore classified as a "Low" hazard potential structure.	

APPENDIX

C

Hydrologic & Hydraulic Data

ETRA MILL POND DAM
APPENDIX C
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

TABLE OF CONTENTS

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
ETRA MILL POND DAM	1	JFR	5-28-81	1800-006-114
		VKE	6/8/81	

SNYDER COEFFICIENTS

$C_t = 2.0$
$C_p = 0.6$
} Determined by Philadelphia C.O.E.

PERRINEVILLE LAKE

$$T_p = C_t (L \cdot L_{CA})^{0.3}$$

$L = 2.04$ mi., $L_{CA} = 1.09$ mi.

$$T_p = 2.0 (2.04 \times 1.09)^{0.3}$$

$$= 2.54 \text{ hours}$$ /

ETRA MILL POND

$$T_p = C_t (L \cdot L_{CA})^{0.3}$$

$L = 6.06$ mi., $L_{CA} = 2.32$ mi.

$$T_p = 2.0 (6.06 \times 2.32)^{0.3}$$

$$= 4.42 \text{ hours}$$ /

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
ETRA MILLS POND DAM	2	JFR	6-1-81	1800-006-114

✓ 6/8/81

ONE HUNDRED YEAR ISTORM DEVELOPMENT

RAINFALL FOR 100 YEAR RETURN *

DURATION	RAINFALL
30 MIN.	2.4"
1 HR.	3.2"
2 HR.	3.9"
3 HR.	4.3"
6 HR.	5.2"
12 HR.	6.2"
24 HR.	7.2"

* FROM TP-40, U.S. WEATHER BUREAU

THE FOLLOWING HYPOTHETICAL HYETOGRAPH WAS DEVELOPED USING THE SCS METHOD OF RAINFALL DISTRIBUTION. DATA FOR THE STORM WAS ACQUIRED FROM AN ACCUMULATED RAINFALL-DURATION CURVE. THE 24-HOUR MASS CURVE WAS DIVIDED INTO 15 MINUTE INTERVALS TO OBTAIN THE CORRESPONDING RAINFALL INCREMENTS.

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
ETRA MILLS POND DAM	3	JFR	6-1-81	1800-006-114

6/4/81

100 YR. STORM DISTRIBUTION

TIME INTERVAL (HOURS) FROM	TO	RAINFALL INCREMENT (INCHES)	NUMBER OF INCREMENTS
0	4 3/4	.02	19
4 3/4	7 1/4	.03	10
7 1/4	8	.04	3
8	9	.05	4
9	9 1/2	.06	2
9 1/2	10	.07	2
10	10 1/2	.08	2
10 1/2	10 3/4	.10	1
10 3/4	11	.12	1
11	11 1/4	.14	1
11 1/4	11 1/2	.20	1
11 1/2	11 3/4	.34	1
11 3/4	12	.90	1
12	12 1/4	1.50	1
12 1/4	12 1/2	.41	1
12 1/2	12 3/4	.20	1
12 3/4	13	.16	1
13	13 1/4	.13	1
13 1/4	13 1/2	.10	1
13 1/2	13 3/4	.09	1
13 3/4	14 1/4	.08	2
14 1/4	14 3/4	.07	2
14 3/4	15 1/4	.06	2
15 1/4	16	.05	3
16	17	.04	4
17	19 1/2	.03	10
19 1/2	24	.02	18
		7.20"	96

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
ETRA MILLS POND DAM	4	JFR	6-02-81	1800-006-114

✓ 6/9/81

PEAK DISCHARGE FOR 100-YR. STORM

REFERENCE: SPECIAL REPORT 38, "MAGNITUDE AND FREQUENCY OF FLOODS IN NEW JERSEY WITH EFFECTS OF URBANIZATION", NEW JERSEY D.E.P., 1974.

$$Q_{100} = 136 \cdot A^{0.84} S^{0.26} St^{-0.51} I^{0.14}$$

ETRA MILLS

A = drainage area = 6.3 sq.mi.

S = main channel slope, ft. per mi.

$$= \frac{160 - 100}{4.55} = 13.2 \frac{ft.}{mi.}$$

St = surface storage index
= 2.5, avg. for Raritan River Basin

I = index of manmade impervious cover
= 5.2, avg. for Raritan River Basin

$$Q_{100} = 136 (6.3)^{.84} (13.2)^{.26} (2.5)^{-.51} (5.2)^{.14} = \underline{985} \text{ cfs}$$

PERRINEVILLE

A = 2.8 sq.mi.

$$S = \frac{255 - 165}{1.53} = 58.7 \frac{ft}{mi}$$ ✓

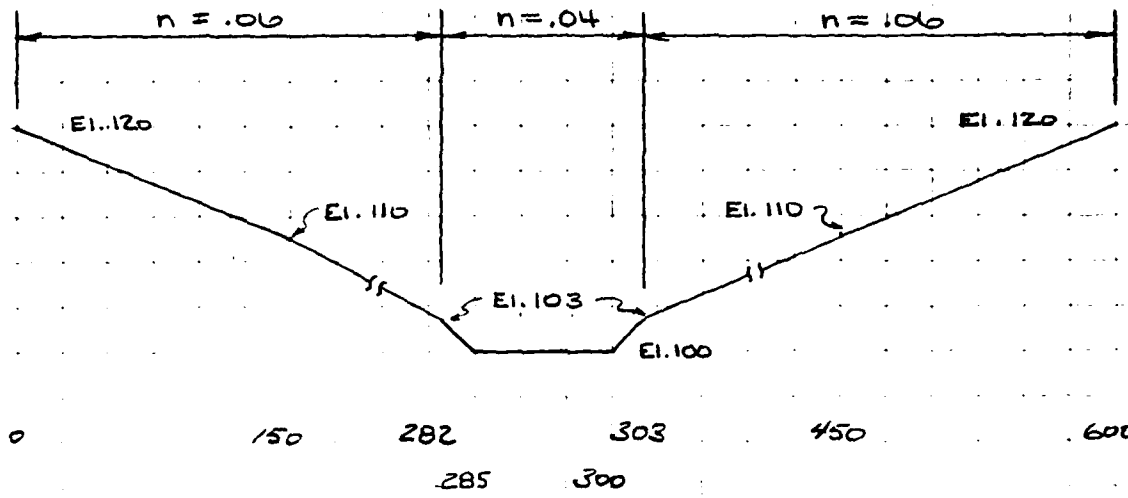
$$Q_{100} = 136 (2.8)^{.84} (58.7)^{.26} (2.5)^{-.51} (5.2)^{.14} = \underline{735} \text{ cfs}$$ ✓

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
ETRA MILLS POND DAM	5	JFR	6-01-81	1800-006-114

✓ 6/9/81

TYPICAL CHANNEL SECTION UPSTREAM OF ETRA MILLS POND



REACH LENGTH = 24,500 ft.

CHANNEL SLOPE = $\frac{160 - 100}{24{,}500}$ = 0.002 $\frac{ft}{ft}$

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Etra Mills Pond Dam	6	REH	5/27/81	1800.006.114

Ref: Hyd. Design of the Box-Inlet Drop Spillway 6/9/81
Agriculture Hbk #301

At Etra Mills

Stage-Discharge - Spillway C = 3.43 (uncorrected)

WSE	H_1 (ft)	H_2 (ft)	L_1 (ft)	L_2 (ft)	H/W	Correction for Head	Corr. for B/W	C
98.3	0	0	12	49	0	—	.99	—
99.3	1	0.7			106	.82		2.78
100.3	2	1.7			.11	.88		2.99
101.3	3	2.7			.17	.92		3.12
102.3	4	3.7			122	.94		3.19
103.3	5	4.7			128	.96		3.26
104.3	6	5.7			133	.97		3.29
105.3	7	6.7			139	99		3.36
106.3	8	7.7			144	99		3.36
107.3	9	8.7			.5	1.00		3.39

WSE	H_1	H_2	$Q_1 = C(12)H_1^{3/2}$	$Q_2 = C(49)H_2^{3/2}$	Q_{Total}
98.3	0	0	0 cfs	0 cfs	0 cfs
99.3	1	.7	33	80	113
100.3	2	1.7	101	325	426
101.3	3	2.7	195	678	873
102.3	4	3.7	306	1112	1418
103.3	5	4.7	437	1628	2065
104.3	6	5.7	580	2194	2774
105.3	7	6.7	747	2855	3602
106.3	8	7.7	912	3518	4430
107.3	9	8.7	1098	4263	5361

For embankment overtopping use $Q = CLH^{3/2}$

C = 2.6, L = 400 feet

embankment Crest elevation = 99.93

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Etra Mills Pond Dam	7	REH ✓	5/27/81 6/9/81	1800.006.114

At Etra Mills

Stage - Area

Stage	Surface Area
98.3	21 acres
100.0	40 acres
120.0	468 acres

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Etra Mills Pond Dam	8	REH	5/27/91	1800.006.11

6/9/81

Upstream Dam @ Perrineville

STAGE - Discharge

$C = CLH^{3/2}$ $C=3.6, L=30$ feet

Stage	H	Q (cfs)
164	0	0
165	1	108
166	2	395
167	3	561
168	4	864
169	5	1207
170	6	1587
171	7	2000
172	8	2444
173	9	2916

For embankment overtopping use $CLH^{3/2}$ $C=2.6, L=450'$
embankment crest elev = 170

STAGE - AREA

Stage	Surface Area
164 (normal pool)	13.7 Acres
170	44 Acres
180	92 Acres

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
ETRA MILLS POND DAM	9	JFR	7-27-81	1800-006-114

DRAWDOWN ANALYSIS

16" Ø drain pipe at El. 88.9 ; Normal Pool, El. 98.3

$$t = \frac{\forall}{Q}$$

$\forall = 3450.8923\,(h_2 - h_1)^3$ ft^3 ; By Integration

$Q = A_p\sqrt{2gH} = 11.205\,H^{1/2}$ cfs

Δ DEPTH	Δ∀ (ft³)	H_{AVG} (ft)	Q (cfs)	t (sec)
98.30 - 97.36	776,753	8.93	33.5	23,187
97.36 - 96.42	621,976	7.99	31.7	19,621
96.42 - 95.48	484,396	7.05	29.8	16,255
95.48 - 94.54	364,013	6.11	27.7	13,141
94.54 - 93.60	260,829	5.17	25.5	10,229
93.60 - 92.66	174,841	4.23	23.0	7,602
92.66 - 91.72	106,051	3.29	20.3	5,224
91.72 - 90.78	54,459	2.35	17.2	3,166
90.78 - 89.84	20,064	1.41	13.3	1,509
89.84 - 88.90	2866	.47	7.7	372
	Σ 2,866,248			100,305 sec

$$t_{TOTAL} = \frac{100,305 \text{ sec}}{86400} = 1.2 \text{ days}$$

```
1**********
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
  DAM SAFETY VERSION     JULY 1978
    LAST MODIFICATION  01 APR 80
 **********
     1                A1                                NATIONAL DAM SAFETY PROGRAM
     2                A2                                    ETRA MILLS POND DAM
     3                A3                                  100 YEAR STORM ROUTING
     4                B    300      0      15       0       0       0       0       0      -4       0
     5                B1     3
     6                K      0  LAKE-1       0       0       0       0       1
     7                K1                              RUNOFF TO PERRINEVILLE LAKE
     8                M      0      1     2.8
     9                O      0     96       0
    10                O1   .02    .02    .02    .02    .02    .02    .02    .02    .02    .02
    11                O1   .02    .02    .02    .02    .02    .02    .02    .02    .02    .03
    12                O1   .03    .03    .03    .03    .03    .03    .03    .03    .03    .04
    13                O1   .04    .04    .05    .05    .05    .05    .06    .06    .07    .07
    14                O1   .08    .08    .10    .12    .14    .20    .34    .90   1.50    .41
    15                O1   .20    .16    .13    .10    .09    .08    .08    .07    .07    .06
    16                O1   .06    .05    .05    .05    .04    .04    .04    .04    .03    .03
    17                O1   .03    .03    .03    .03    .03    .03    .03    .03    .02    .02
    18                O1   .02    .02    .02    .02    .02    .02    .02    .02    .02    .02
    19                O1   .02    .02    .02    .02    .02    .02
    20                T                                                    -1    -60
    21                W  2.54   0.60
    22                X  -1.5   -.05      2
    23                K      1  DAM-1       0       0       0       0       1
    24                K1                            OUTFLOW FROM PERRINEVILLE DAM
    25                Y                                     1       1
    26                Y1     1                                                -164      -1
    27                Y4   164     165     166     167     168     169     170     171     172     173
    28                Y5     0     108     305     561     864    1207    1587    2000    2444    2916
    29                $A  13.7      44      92
    30                $E   164     170     180
    31                $$   164
    32                $D   170     2.6     1.5     450
    33                K      1  LAKE-2       0       0       0       0       1
    34                K1                        PERRINEVILLE OUTFLOW ROUTED TO ETRA
    35                Y                                     1       1
    36                Y1     1                                                  -1
    37                Y6   .06    .04     .06     100     120   24500    .002
    38                Y7     0    120     150     110     282     103     285     100     300     100
    39                Y7   303    103     450     110     600     120
    40                K      0  LAKE-2       0       0       0       0       1
    41                K1                              RUNOFF TO ETRA MILLS POND
    42                M      0      1     6.3
    43                O    -96      0
    44                T                                                    -1     -57
    45                W  4.42   0.60
    46                X  -1.5   -.05      2
    47                K      2  LAKE-2       0       0       0       0       1
    48                K1          COMBINE RUNOFF TO ETRA WITH INFLOW FROM PERRINEVILLE, AT ETRA
    49                K      1  DAM-2       0       0       0       0       1
    50                K1                            OUTFLOW FROM ETRA MILLS POND DAM
    51                Y                                     1       1
    52                Y1     1                                                -98.3      -1
    53                Y4  98.3    99.3   100.3   101.3   102.3   103.3   104.3   105.3   106.3   107.3
    54                Y5     0     113     426     873    1418    2065    2774    3602    4430    5361
    55                $A     0      21      40     468
    56                $E  88.9    98.3     100     120
    57                $$  98.3
    58                $D 99.93     2.6     1.5     400
    59                K     99
                          PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS
```

Sh 10

NATIONAL DAM SAFETY PROGRAM
ETRA MILLS POND DAM
100-YEAR STORM-ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
3	0	0	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO PERRINEVILLE LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE-1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	1	2.80	0.00	2.80	0.00	0.000	0	0	0

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-60.00	0.00	0.00

CURVE NO = 60.00 WETNESS = 1.00 EFFECT CN = 60.00

UNIT HYDROGRAPH DATA
TP= 2.54 CP= .60 NTA= 0

RECESSION DATA
STRTQ= 1.50 QRCSN= .05 RTIOR= 2.00

UNIT HYDROGRAPH 60 END-OF-PERIOD ORDINATES, LAG= 2.54 HOURS, CP= .60 VOL= 1.00

13.	48.	98.	156.	218.	283.	343.	390.	421.	438.
437.	412.	374.	339.	307.	278.	252.	228.	206.	187.
169.	153.	139.	126.	114.	103.	94.	85.	77.	69.
63.	57.	52.	47.	42.	38.	35.	31.	29.	26.
23.	21.	19.	17.	16.	14.	13.	12.	11.	10.
9.	8.	7.	6.	6.	5.	5.	4.	4.	4.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	7.20	2.75	4.45	19989.
										(183.)	(70.)	(113.)	(566.03)

HYDROGRAPH ROUTING

OUTFLOW FROM PERRINEVILLE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM-1	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-164.	-1

STAGE	164.00	165.00	166.00	167.00	168.00	169.00	170.00	171.00	172.00	173.00
FLOW	0.00	108.00	305.00	561.00	864.00	1207.00	1587.00	2000.00	2444.00	2916.00
SURFACE AREA=	14.	44.	92.							
CAPACITY=	0.	165.	830.							
ELEVATION=	164.	170.	180.							

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
164.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
170.0	2.6	1.5	450.

PEAK OUTFLOW IS 617. AT TIME 16.00 HOURS

HYDROGRAPH ROUTING

PERRINEVILLE OUTFLOW ROUTED TO ETRA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
ETRE-2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	RLNTH	SEL
.0600	.0400	.0600	100.0	120.0	24500.	.00200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 120.00 150.00 110.00 282.00 103.00 285.00 100.00 300.00 100.00
303.00 103.00 450.00 110.00 600.00 120.00

STORAGE	0.00	9.50	20.25	32.52	61.09	114.51	192.77	295.86	423.80	576.57
	753.42	949.73	1164.74	1398.44	1650.84	1921.93	2211.72	2520.21	2847.39	3193.27
OUTFLOW	0.00	27.01	86.07	173.18	321.27	571.82	963.82	1530.24	2300.77	3302.86
	4591.51	6177.20	8041.64	10198.93	12663.17	15448.39	18568.44	22037.01	25867.59	30073.49
STAGE	100.00	101.05	102.11	103.16	104.21	105.26	106.32	107.37	108.42	109.47
	110.53	111.58	112.63	113.68	114.74	115.79	116.84	117.89	118.95	120.00
FLOW	0.00	27.01	86.07	173.18	321.27	571.82	963.82	1530.24	2300.77	3302.86
	4591.51	6177.20	8041.64	10198.93	12663.17	15448.39	18568.44	22037.01	25867.59	30073.49

MAXIMUM STAGE IS 104.8

Sh 12

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO ETRA MILLS POND

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE-2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	1	6.30	0.00	6.30	0.00	0.000	0	0	0

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	-1.00	0.00	0.00	1.00	-1.00	-57.00	0.00	0.00

CURVE NO = -57.00 WETNESS = -1.00 EFFECT CN = 57.00

UNIT HYDROGRAPH DATA

TP= 4.42 CP= .60 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 4.38 HOURS, CP= .61 VOL= .99

8.	29.	60.	97.	139.	183.	230.	279.	329.	380.
429.	470.	506.	534.	556.	571.	579.	579.	568.	543.
513.	484.	457.	431.	407.	385.	363.	343.	324.	306.
289.	273.	257.	243.	229.	217.	204.	193.	182.	172.
163.	153.	145.	137.	129.	122.	115.	109.	103.	97.
92.	86.	82.	77.	73.	69.	65.	61.	58.	55.
52.	49.	46.	43.	41.	39.	37.	34.	33.	31.
29.	27.	26.	24.	23.	22.	21.	19.	18.	17.
16.	15.	15.	14.	13.	12.	12.	11.	10.	10.
9.	9.	8.	8.	7.	7.	7.	6.	6.	5.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	7.20	2.45	4.75	39802.
										(183.)	(62.)	(121.)	(1127.07)

COMBINE HYDROGRAPHS

COMBINE RUNOFF TO ETRA WITH INFLOW FROM PERRINEVILLE, AT ETRA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE-2	2	0	0	0	0	1	0	0

HYDROGRAPH ROUTING

OUTFLOW FROM ETRA MILLS POND DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM-2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-98.	-1

STAGE	98.30	99.30	100.30	101.30	102.30	103.30	104.30	105.30	106.30	107.30
FLOW	0.00	113.00	426.00	873.00	1418.00	2065.00	2774.00	3602.00	4430.00	5361.00
SURFACE AREA=	0.	21.	40.	468.						
CAPACITY=	0.	66.	117.	4416.						
ELEVATION=	89.	98.	100.	120.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
98.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Sh 13

DAM DATA

RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

	PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT LAKE-1	747.	542.	207.	69.	2.80
	(21.15)	(15.36)	(5.86)	(1.97)	(7.25)
ROUTED TO DAM-1	617.	504.	207.	70.	2.80
	(17.48)	(14.28)	(5.85)	(1.97)	(7.25)
ROUTED TO LAKE-2	467.	424.	204.	70.	2.80
	(13.21)	(12.01)	(5.77)	(1.97)	(7.25)
HYDROGRAPH AT LAKE-2	981.	839.	408.	138.	6.30
	(27.78)	(23.75)	(11.54)	(3.91)	(16.32)
2-COMBINED LAKE-2	1397.	1248.	611.	208.	9.10
	(39.55)	(35.33)	(17.30)	(5.88)	(23.57)
ROUTED TO DAM-2	1389.	1240.	604.	208.	9.10
	(39.33)	(35.12)	(17.10)	(5.89)	(23.57)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	164.00	164.00	170.00
STORAGE	0.	0.	165.
OUTFLOW	0.	0.	1587.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	167.19	0.00	65.	617.	0.00	16.00	0.00

STATION LAKE-2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	467.	104.8	18.50

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	98.30	98.30	99.93
STORAGE	66.	66.	114.
OUTFLOW	0.	0.	310.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	100.74	.81	149.	1389.	14.75	17.50	0.00

Sh 14

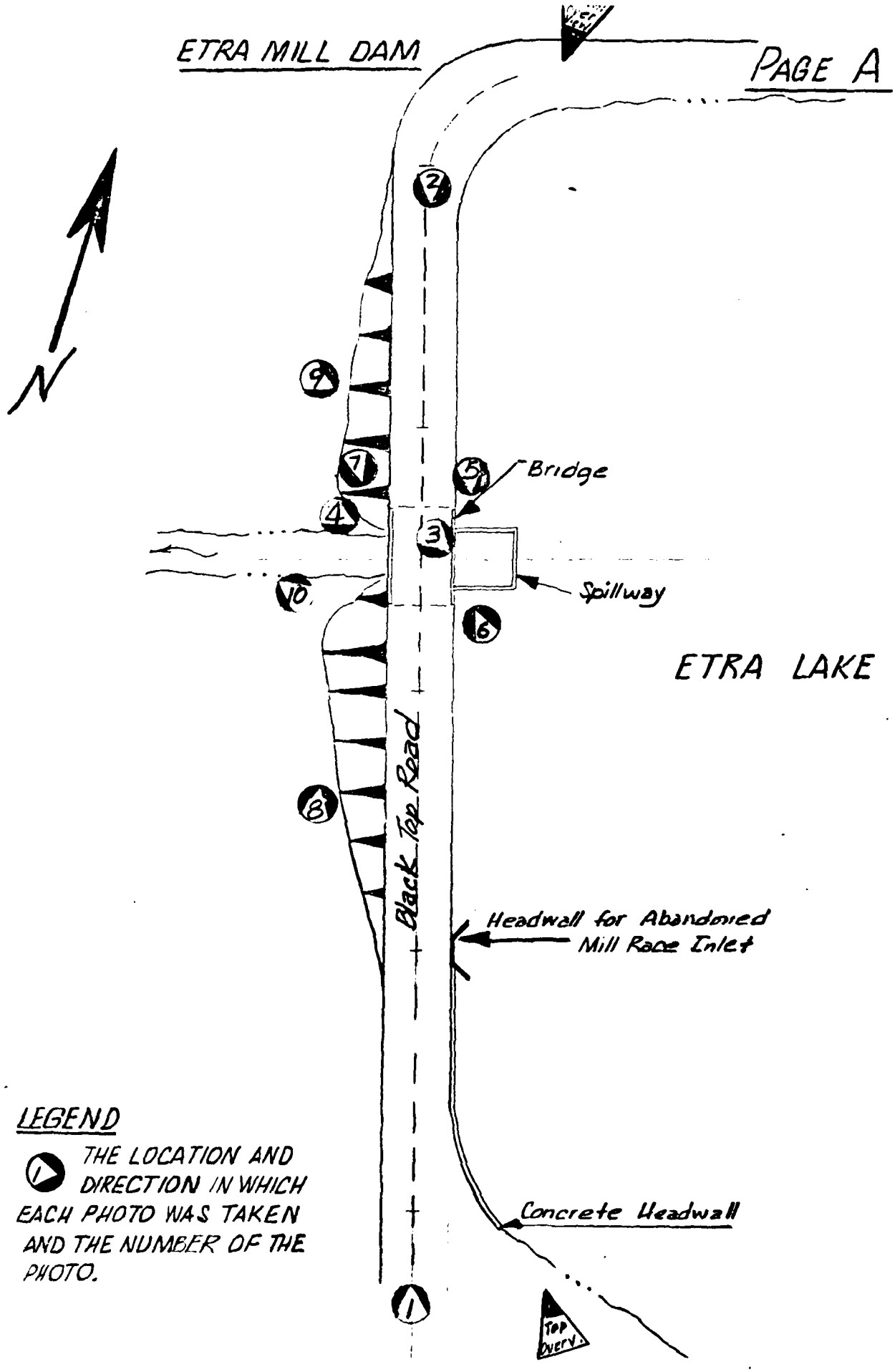
APPENDIX

D

Photographs

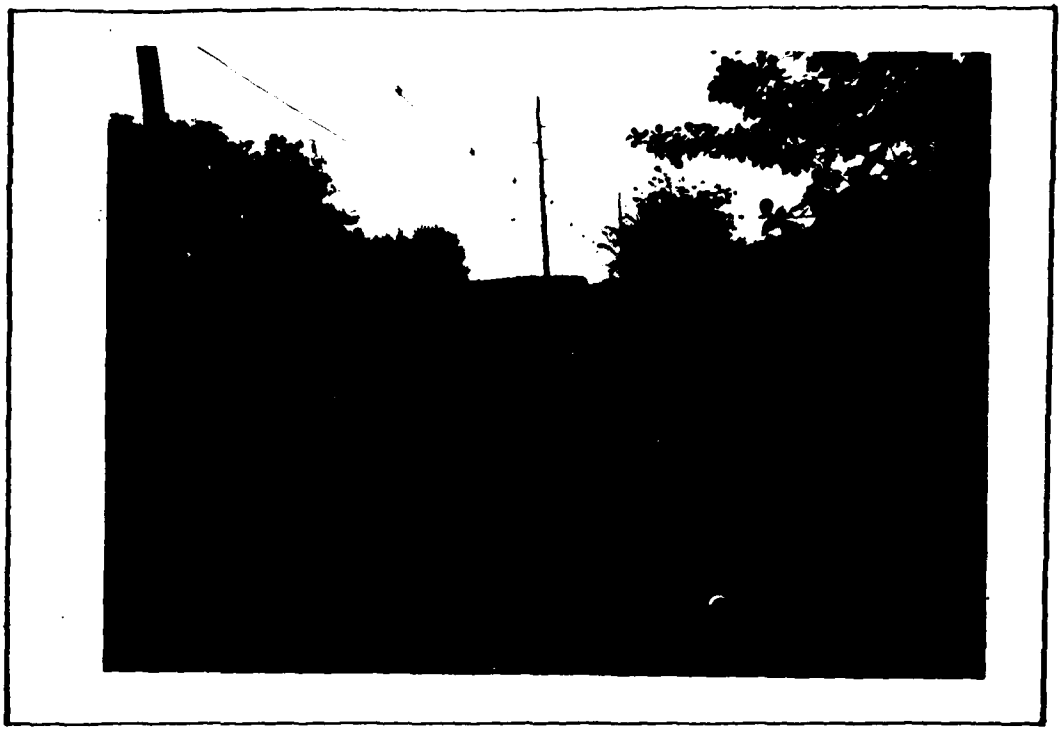
APPENDIX D
SELECTED PHOTOGRAPHS OF THE SITE

ETRA MILL DAM



LEGEND

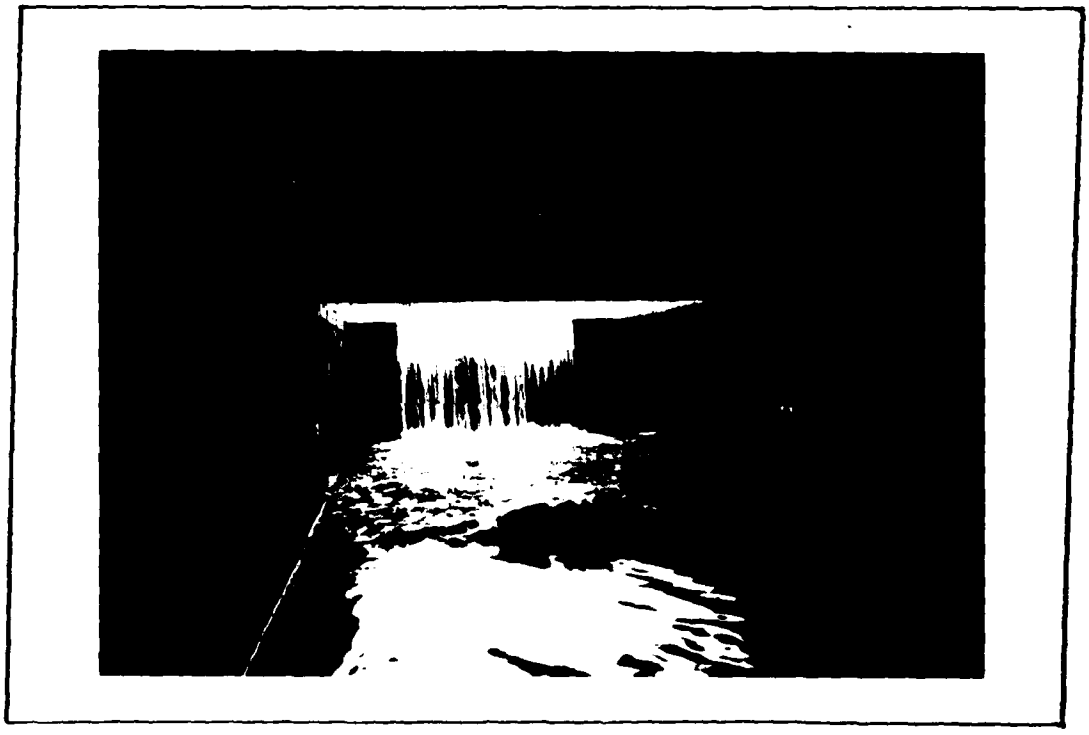
(1) THE LOCATION AND DIRECTION IN WHICH EACH PHOTO WAS TAKEN AND THE NUMBER OF THE PHOTO.



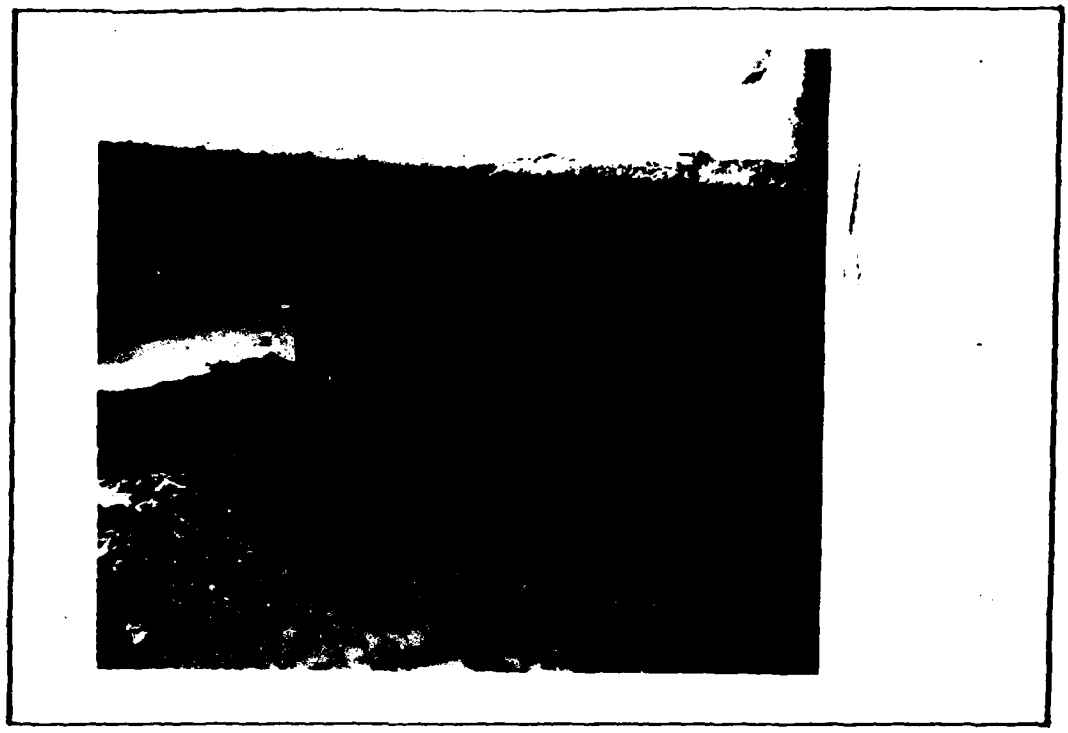
1. PAVED ROADWAY ON THE EMBANKMENT CREST AS VIEWED FROM THE LEFT ABUTMENT. (5/6/81)

2. PAVED ROADWAY ON THE EMBANKMENT CREST AS VIEWED FROM THE RIGHT ABUTMENT. (5/6/81)

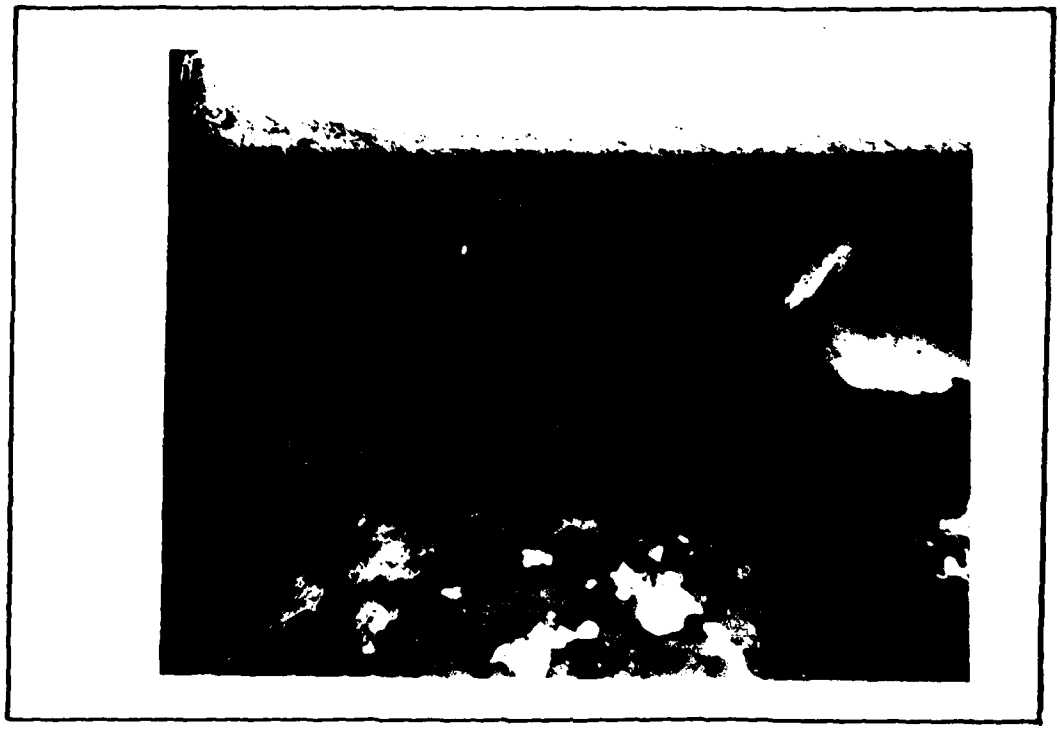
3. THE SPILLWAY AND IMPOUNDMENT. NOTE THE LOW FLOW NOTCH. (5/6/81)



4. SPILLWAY STRUCTURE LOOKING UPSTREAM UNDER THE HIGHWAY BRIDGE. (5/6/81)

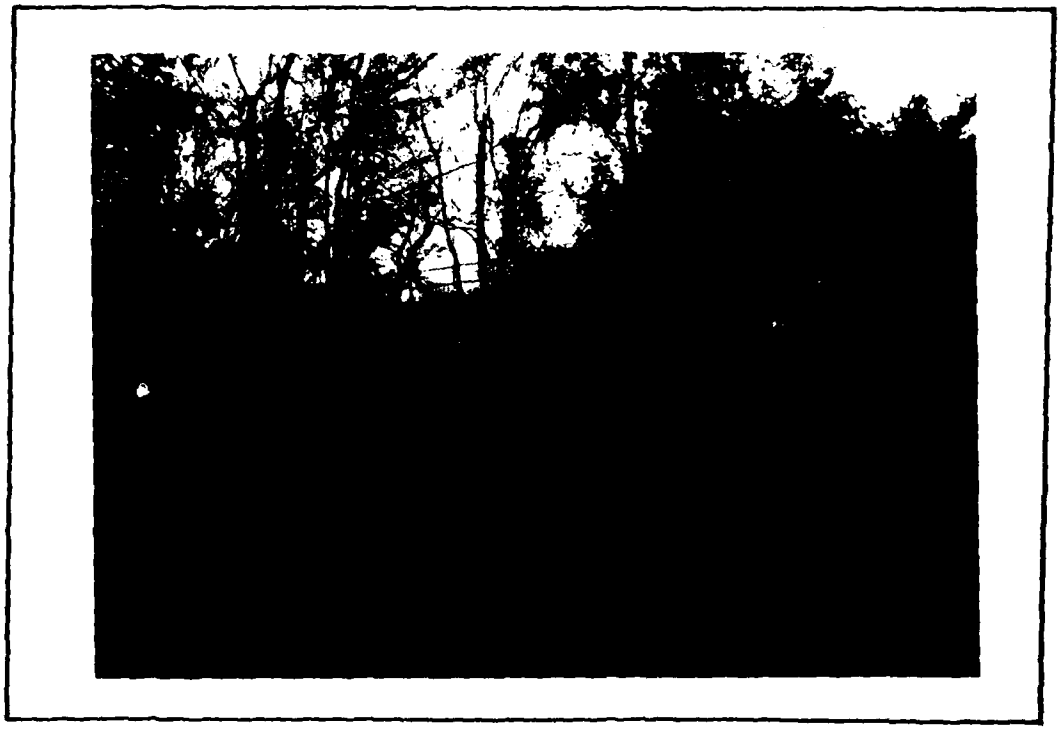


5. LEFT SIDE OF SPILLWAY STRUCTURE. (5/6/81)



6. RIGHT SIDE OF SPILLWAY STRUCTURE. (5/6/81)

7. DOWNSTREAM SIDE OF BRIDGE SHOWING DETERIORATED CONCRETE. (5/6/81)



8. DOWNSTREAM FACE OF THE EMBANKMENT. (5/6/81)

9. SEEPAGE LOCATED AT TOE OF EMBANKMENT, RIGHT SIDE OF SPILLWAY. (5/6/81)

10. DOWNSTREAM CHANNEL. (5/6/81)

APPENDIX

E

Drawings

ETRA MILL POND DAM
APPENDIX E
DRAWINGS

TABLE OF CONTENTS

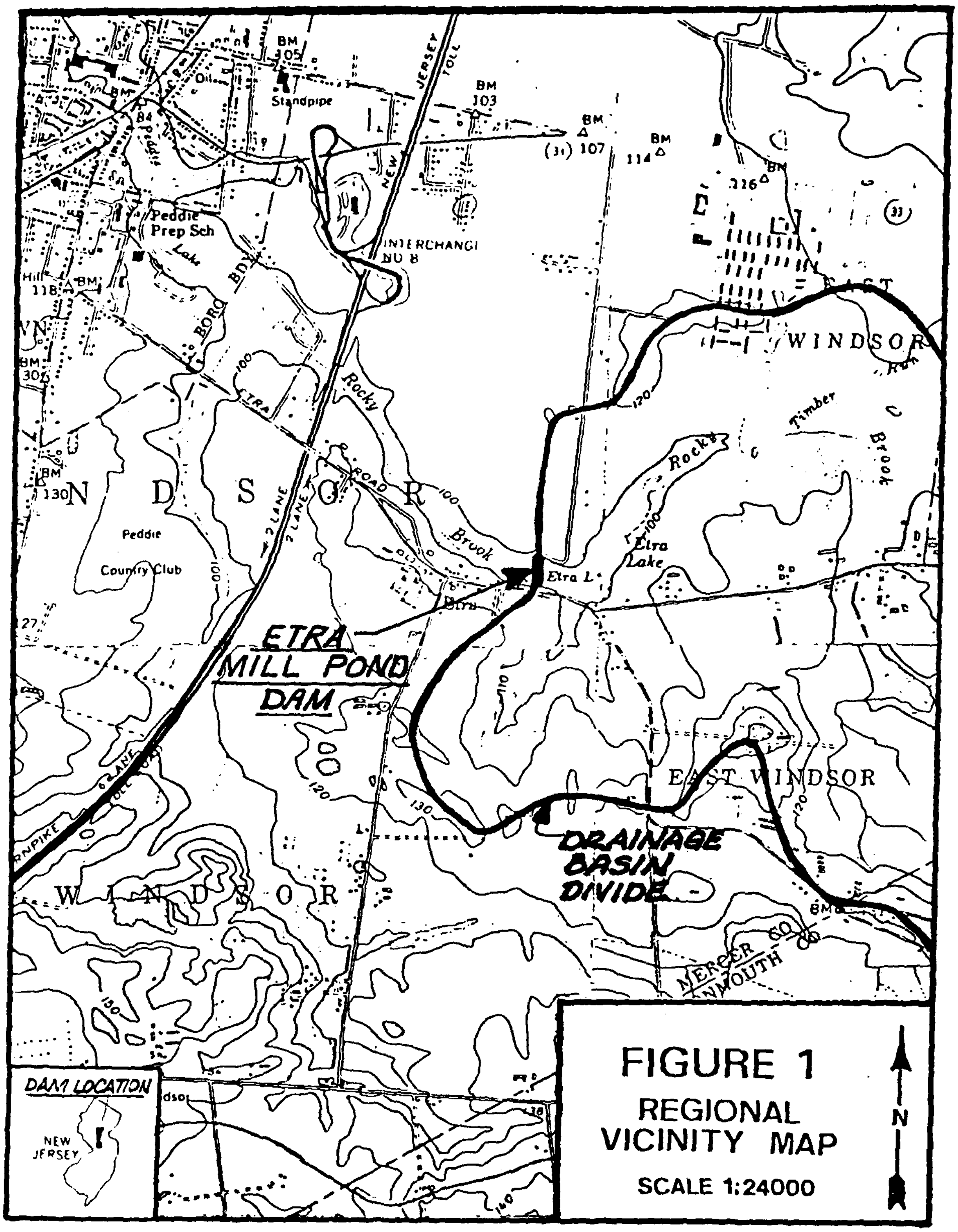
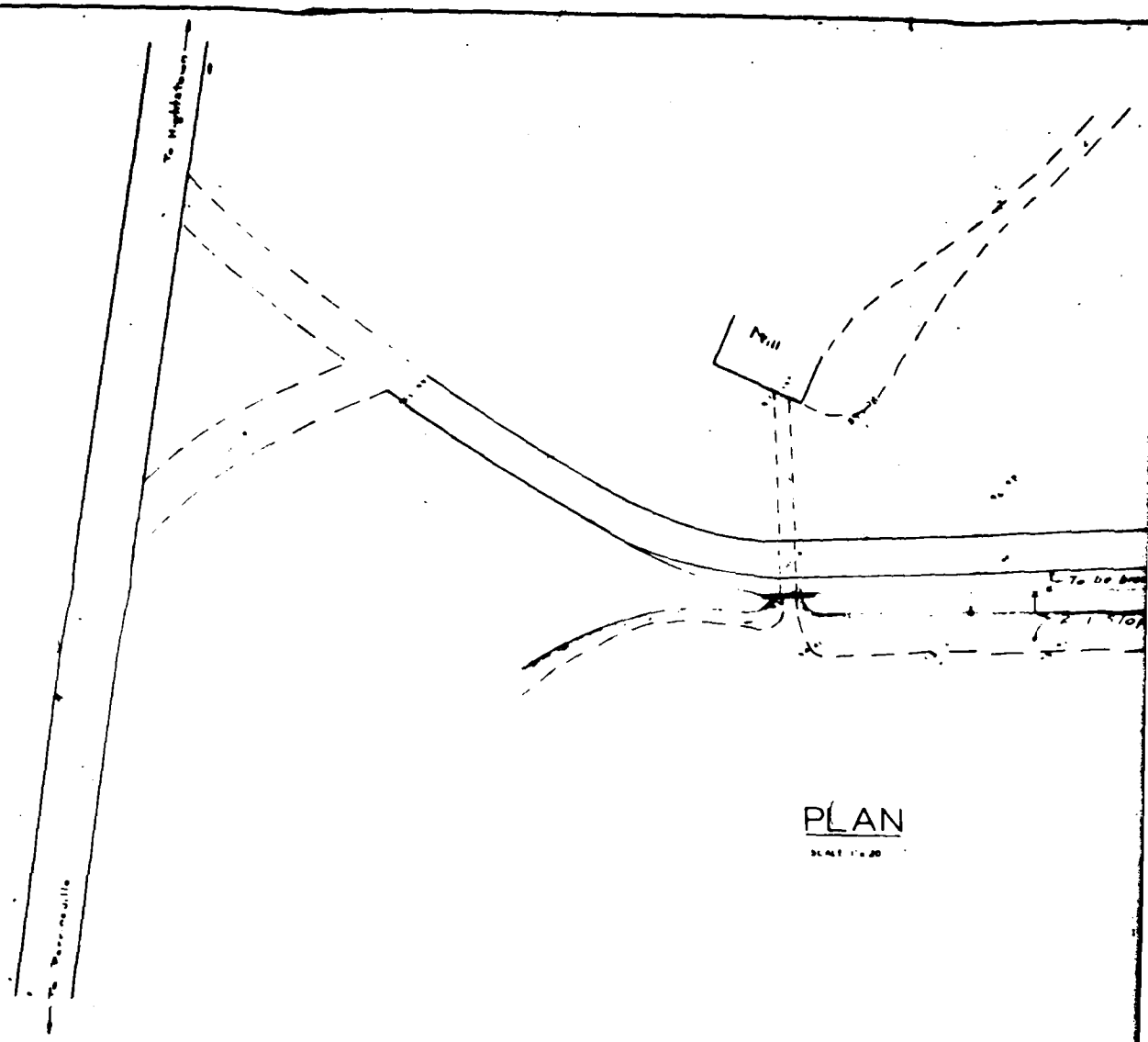
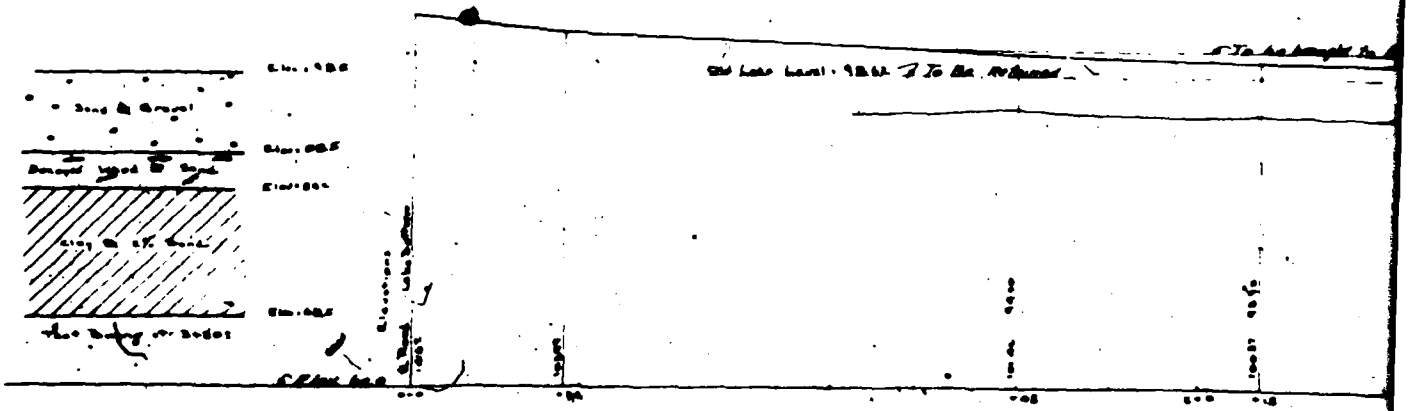


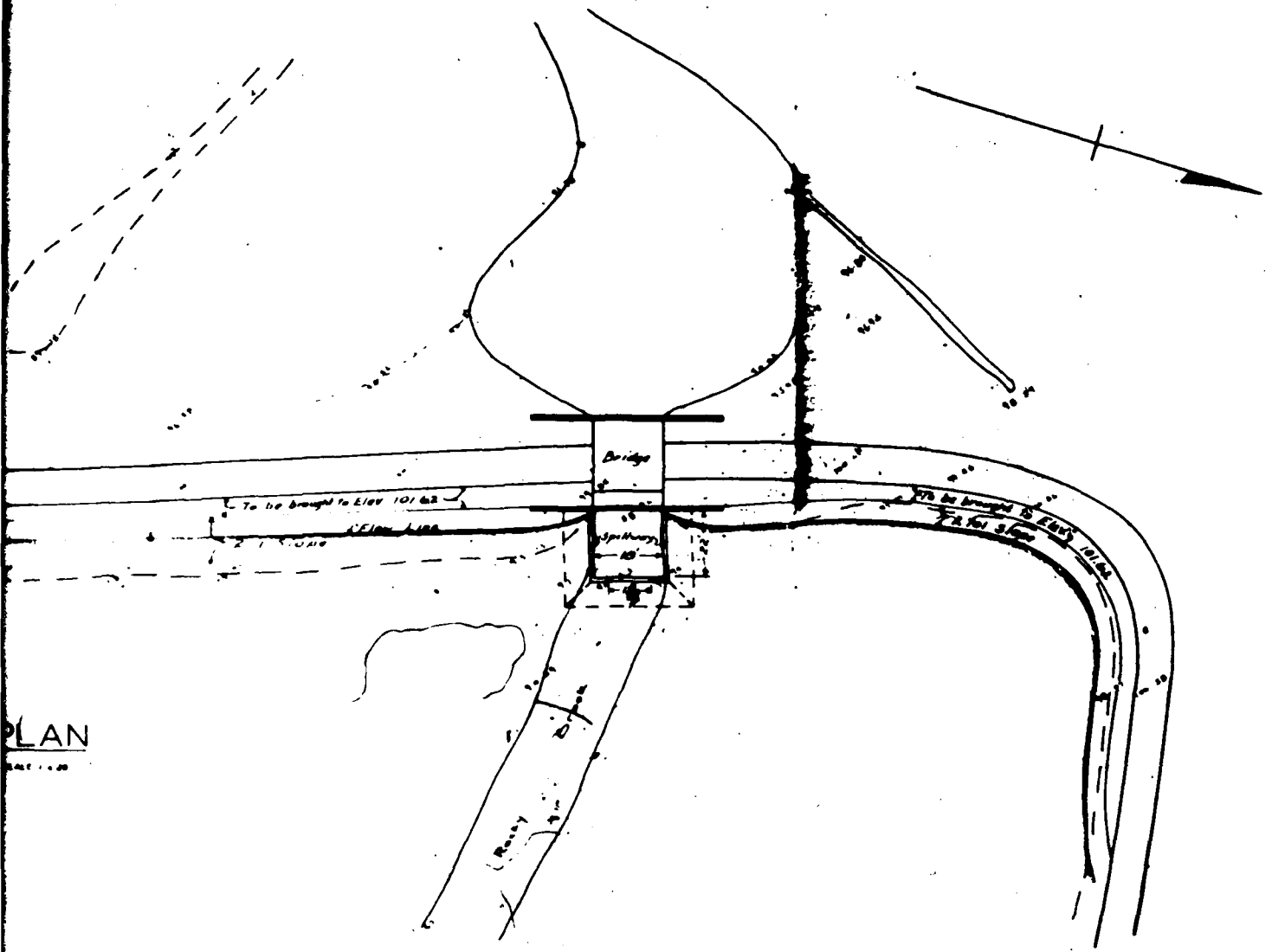
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24000



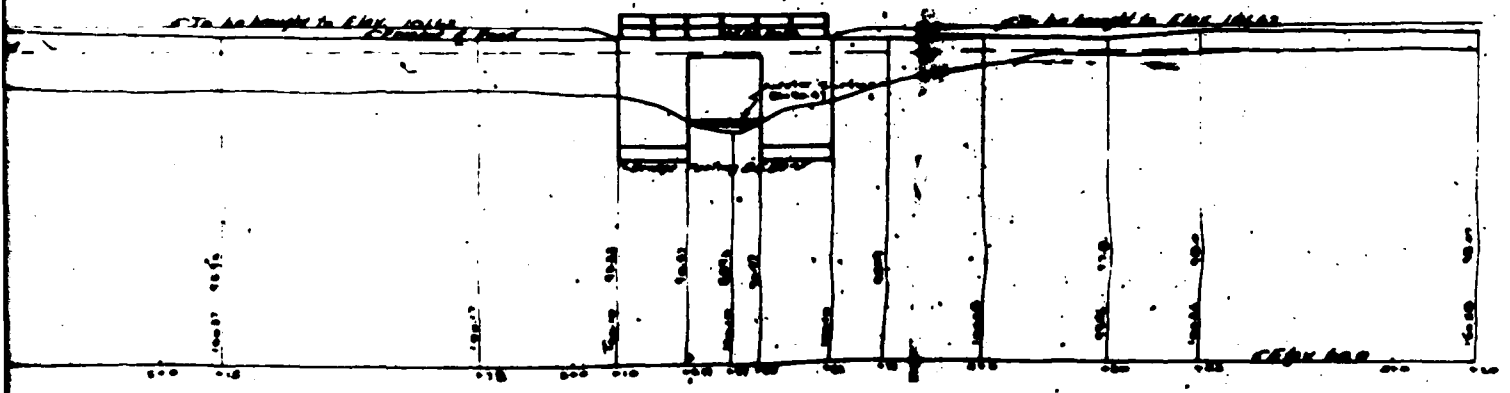
PLAN



PROFILE



PLAN



ROFILE

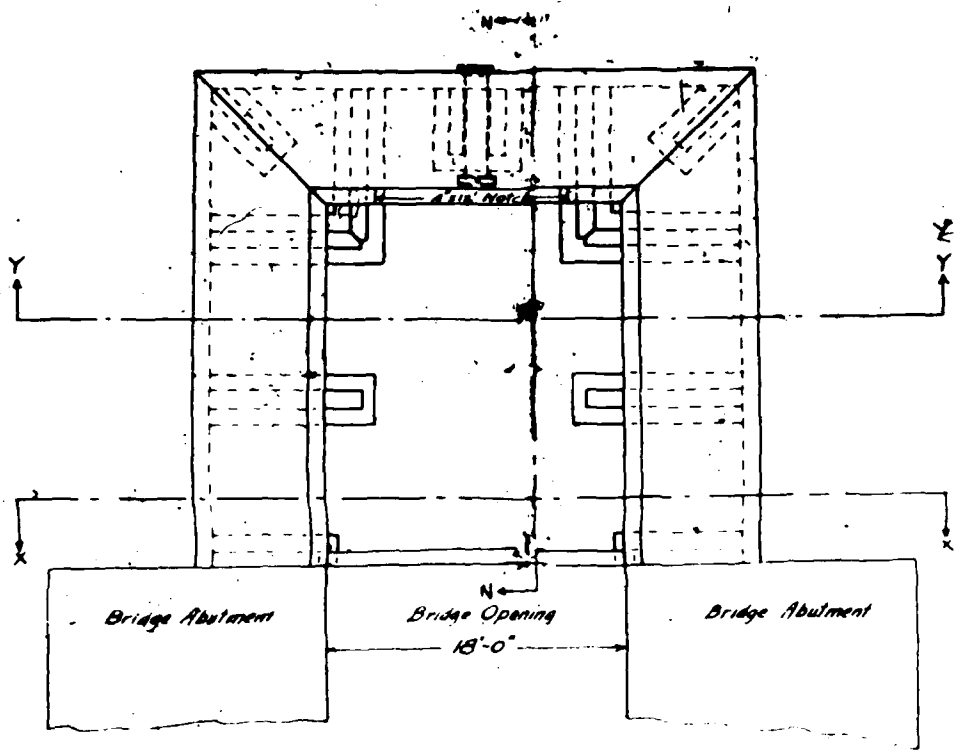
MR. A. KATZ

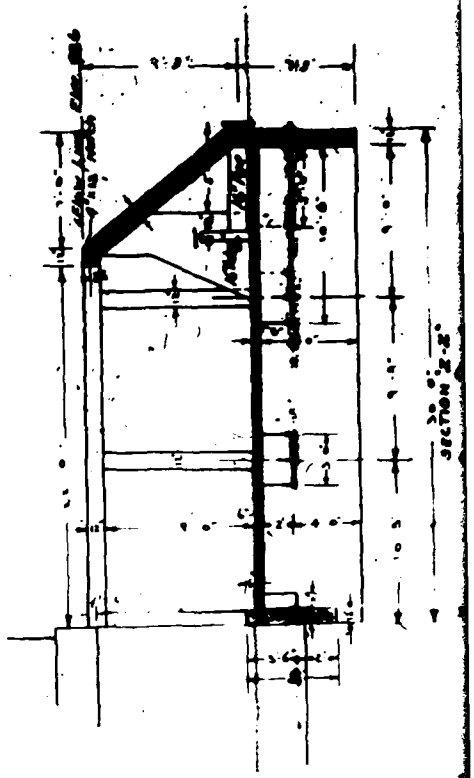
DAM

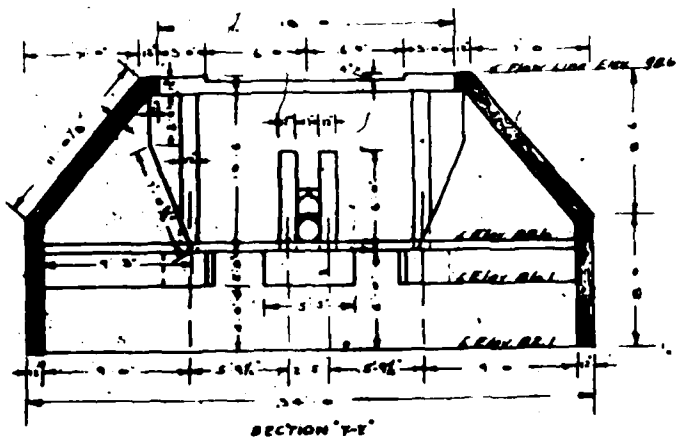
JOHN L. WEBER, INC.

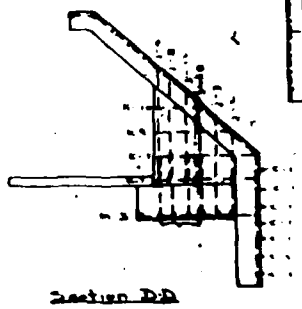
SHEET 2

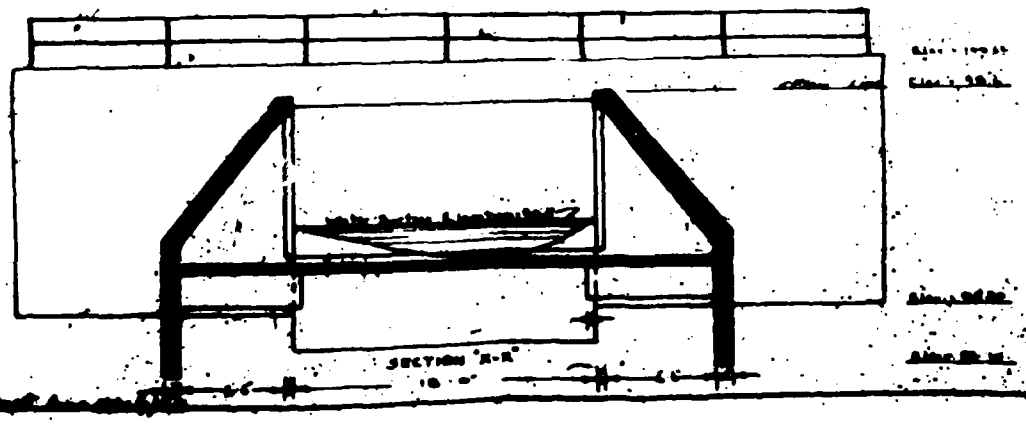
2


Bridge Abutment
Bridge Opening
18'-0"
Bridge Abutment




SECTION "E-E"


Section D-D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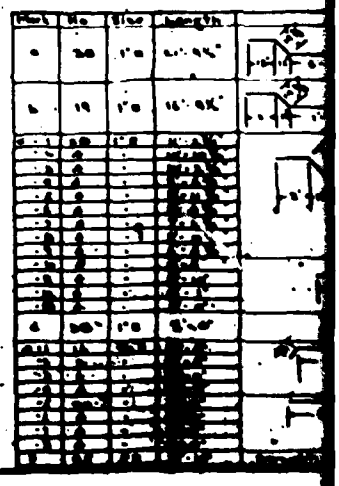
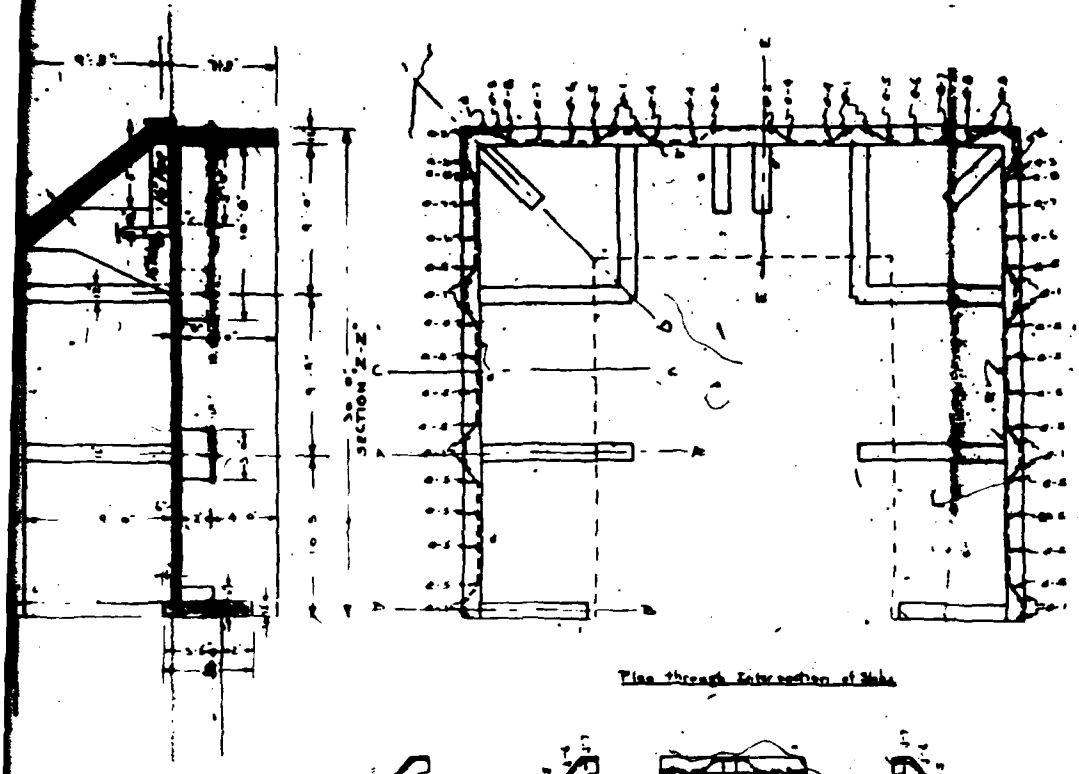
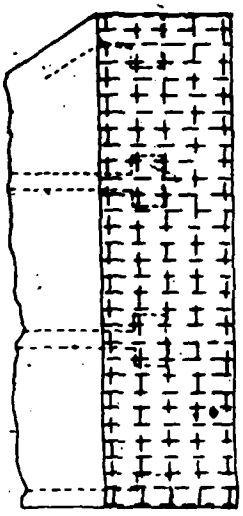
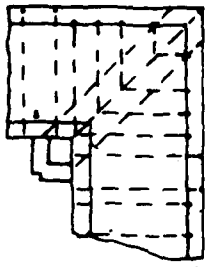




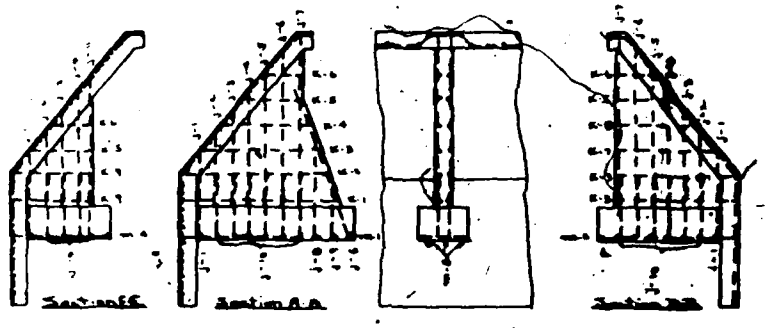
Plan through intersection of Walls



Vertical Wall



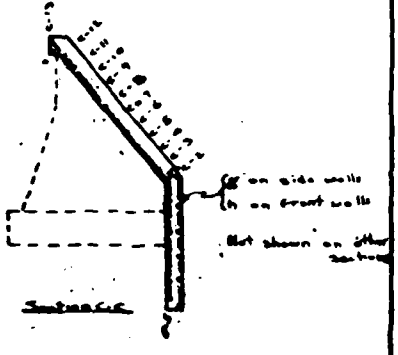
Plan of Coping



Section C-C

Section A-A

Section B-B



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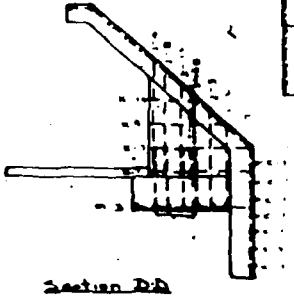
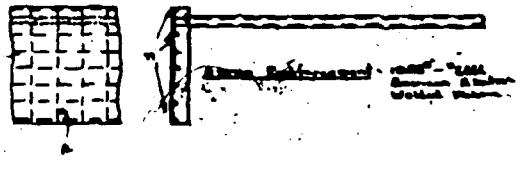
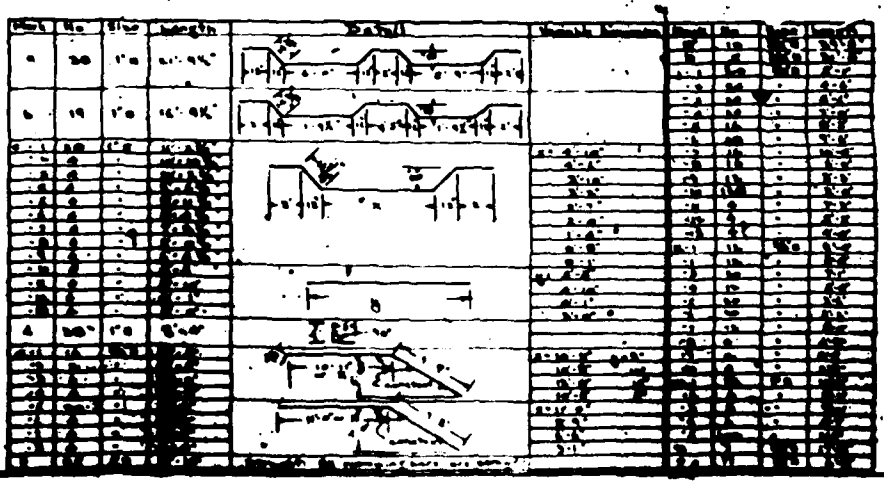
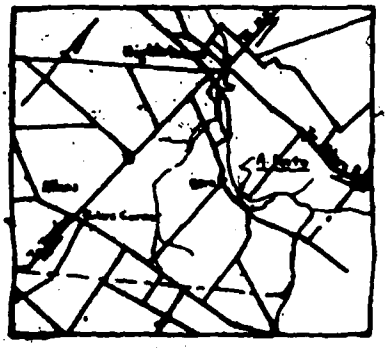


Section D-D







SPILLWAY

MR. A. KATZ

DAM

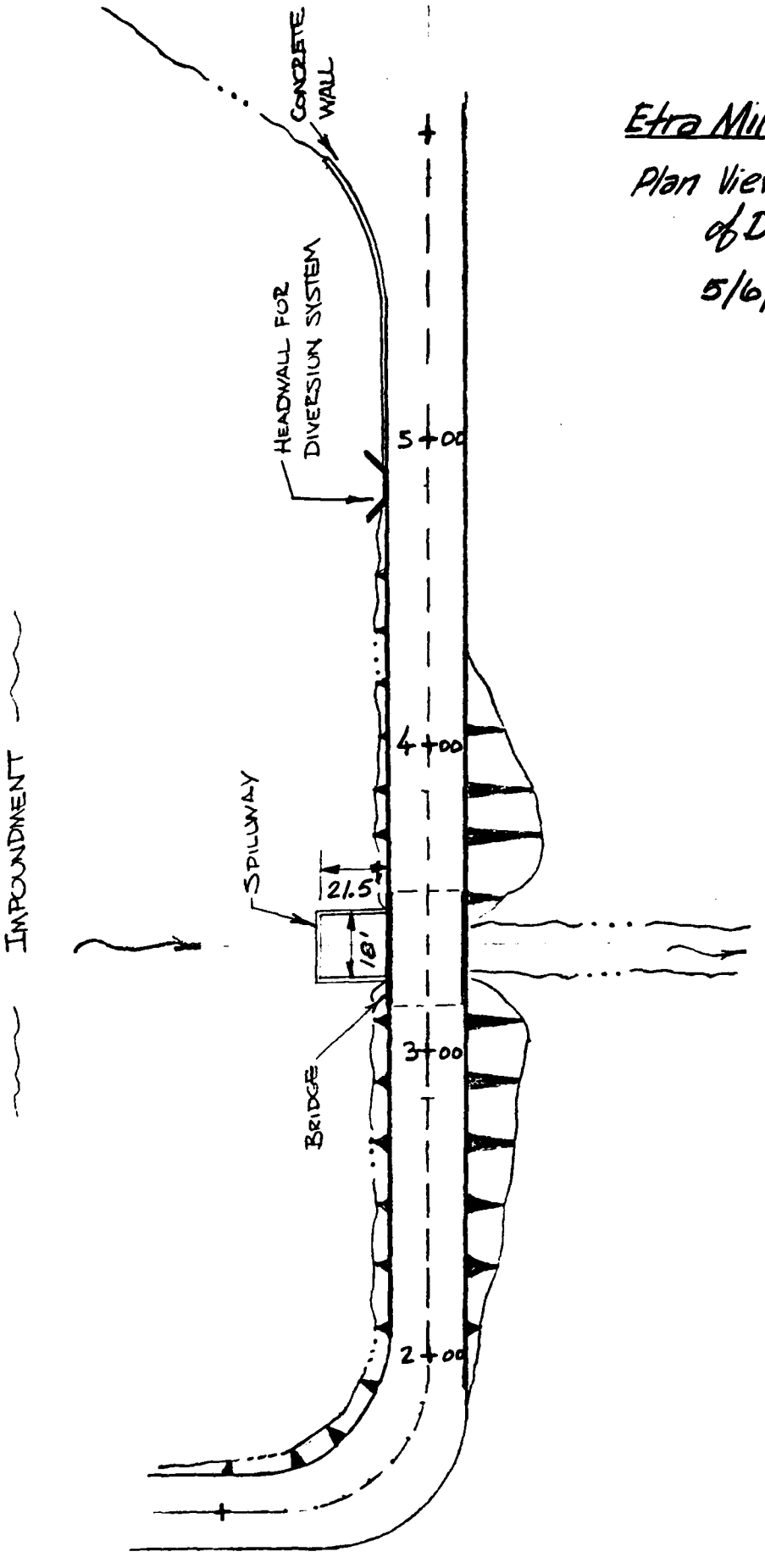
JOHN L. WEBER, INC.

SHEET 3

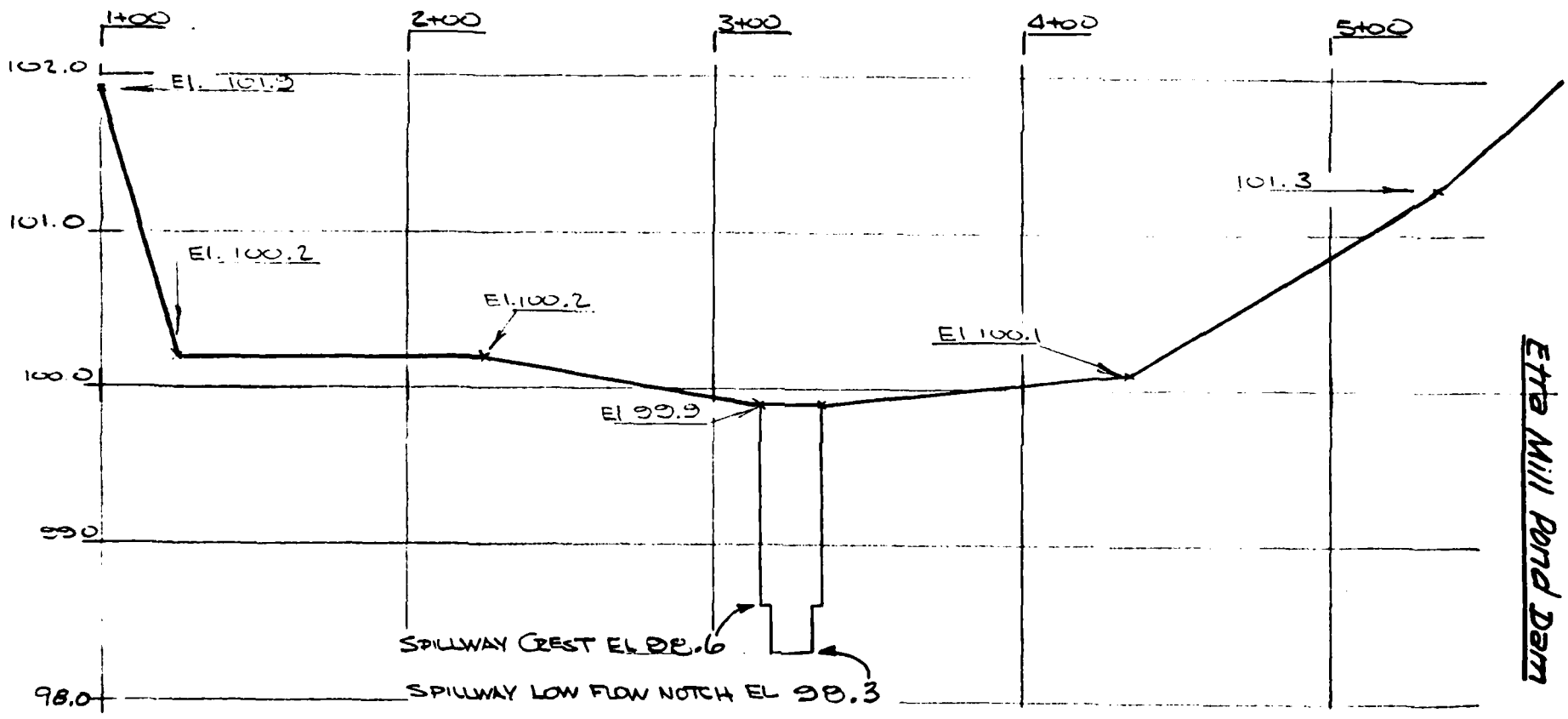
Etra Mill Pond Dam

Plan View Sketch of Dam

5/6/81



Sh 4



Etta Mill Pond Dam

SURVEY-VERTICAL CREST ALIGNMENT
MAY 6, 1981

9A 5

APPENDIX

F

Site Geology

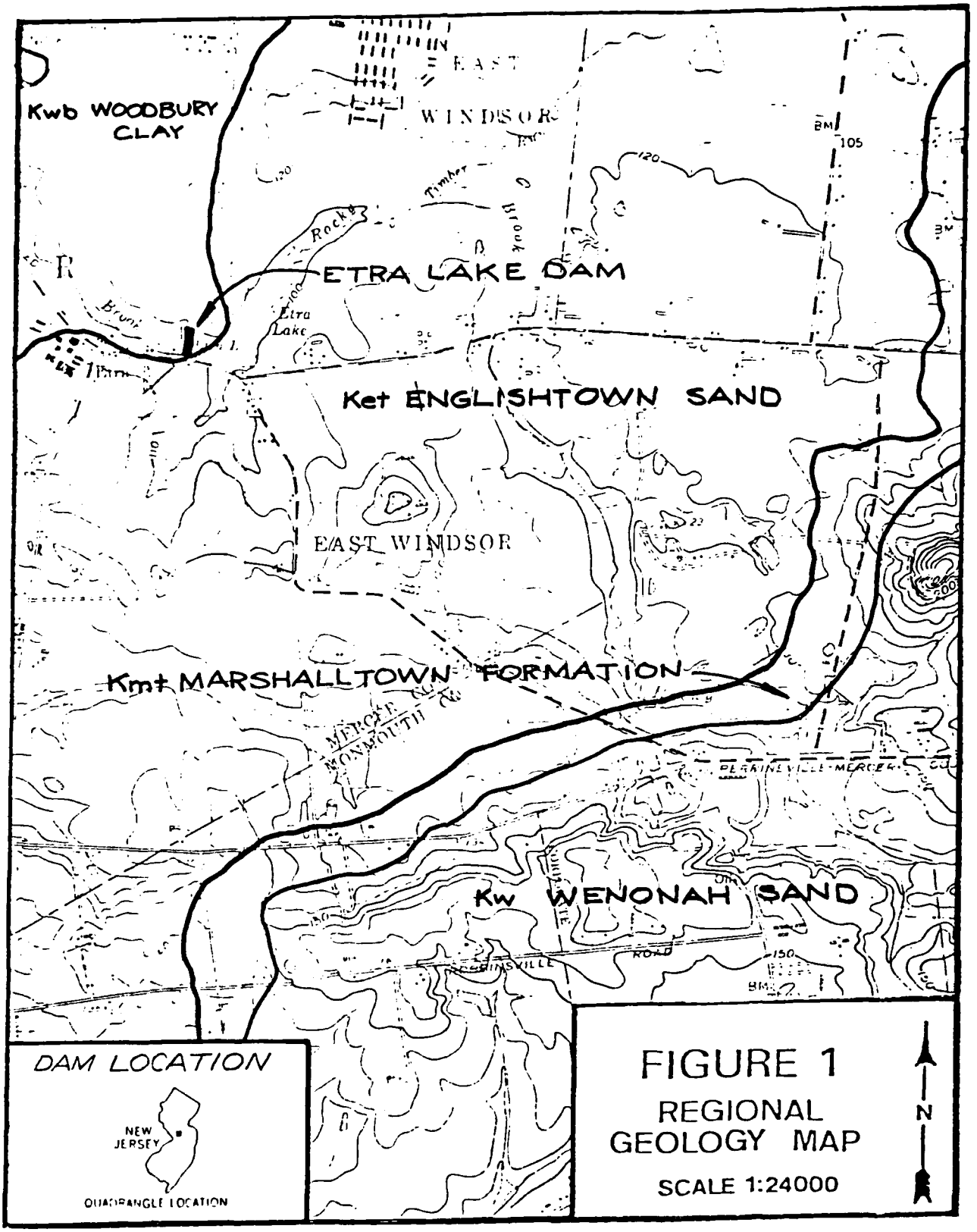
SITE GEOLOGY

ETRA LAKE DAM

Etra Lake Dam is located in Mercer County within the northwesterly limits of the Atlantic Coastal Plain physiographic province. The project rests on medium to fine grained marine sediments of Cretaceous age represented by the Englishtown formation. Younger sediments of Quaternary age, represented by the sands and gravels of the Pennsauken formation, mantle the underlying marine formation forming caps on terraces and topographic highs. The Englishtown formation strikes N.65^{O}E. and dips gradually to the southeast.

The outcrop area where granular in nature may serve as recharge for the Englishtown aquifer used in New Jersey as a water supply source.

Bedrock is estimated to be about 300' feet below ground surface and to consist of highly weathered Paleozoic metamorphics.


Kwb WOODBURY CLAY
ETRA LAKE DAM
Ket ENGLISHTOWN SAND
EAST WINDSOR
Kmt MARSHALLTOWN FORMATION
Kw WENONAH SAND
Rocky Brook
Timber Brook
Etra Lake
Brunt
MERCER MONMOUTH
PENNINGTON ROAD
PENNINGTON
DAM LOCATION
NEW JERSEY
QUADRANGLE LOCATION
FIGURE 1
REGIONAL GEOLOGY MAP
SCALE 1:24000
N